

INTERTECH



Faculty Advisors



IIT Armour College of Engineering
ILLINOIS INSTITUTE OF TECHNOLOGY



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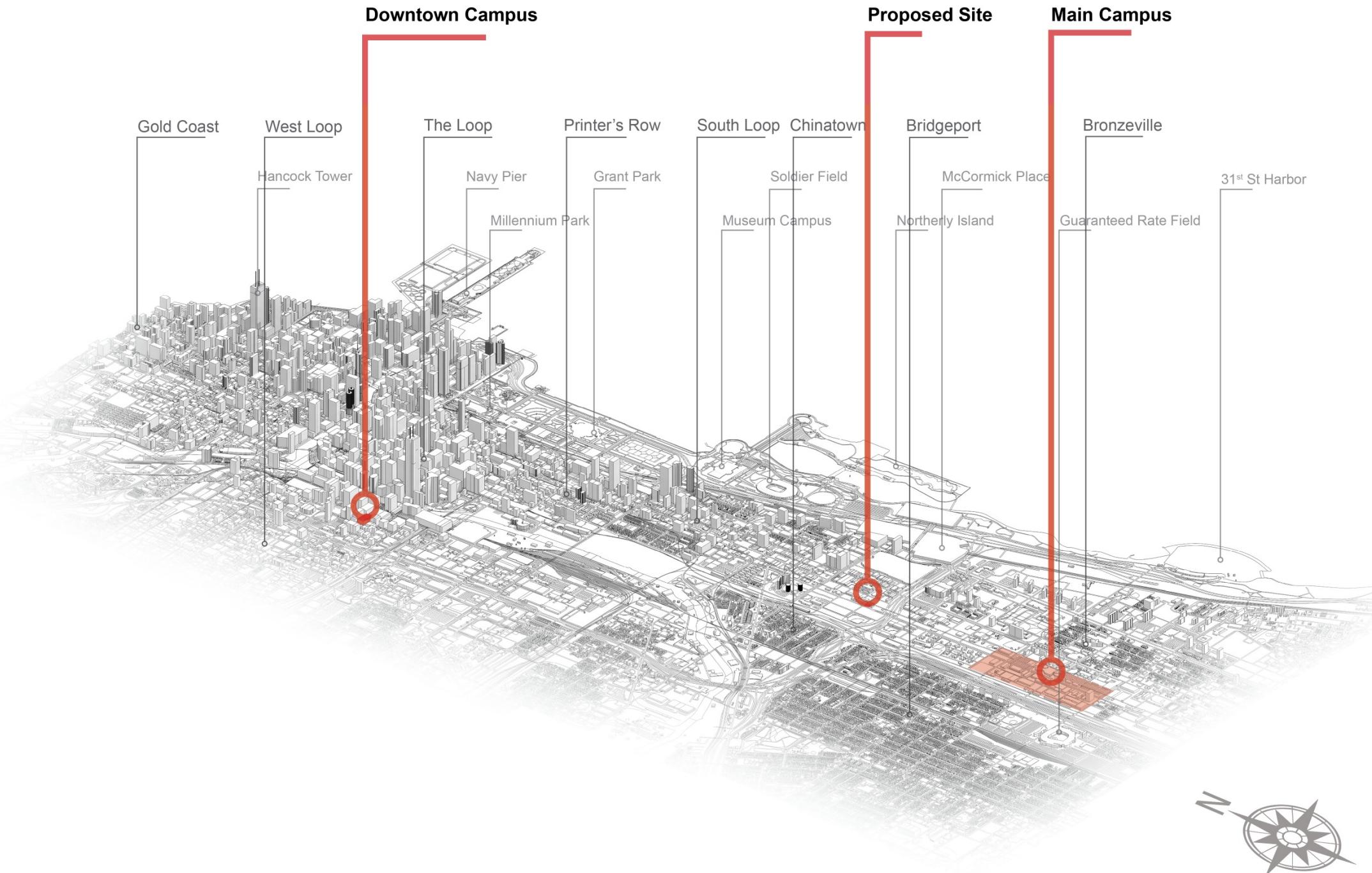
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Associate Professor

Sponsors



IMBERT INTERNATIONAL INC.



**Introduction**

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Interiors

Energy Analysis

Envelope

IAQ + Ventilation

Constructability

MEP Design

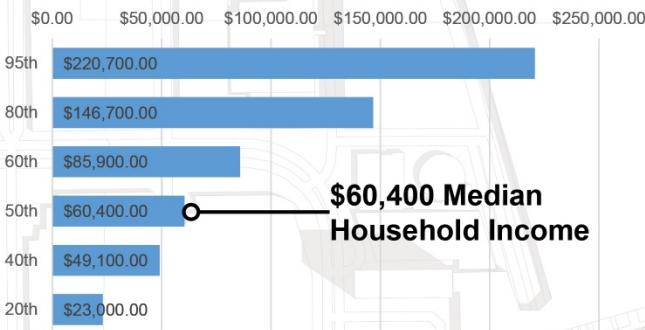
Energy Results

Finances

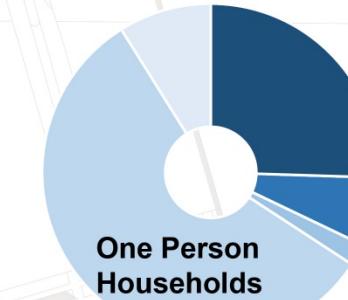
Innovation

Introduction**Ideal for Graduate Students and Young Professionals**

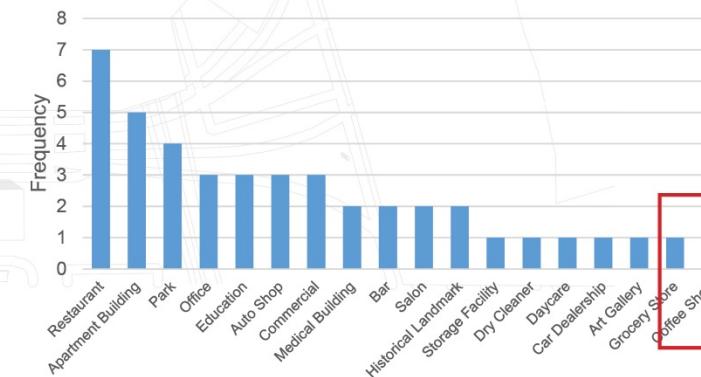
Household Income Percentiles

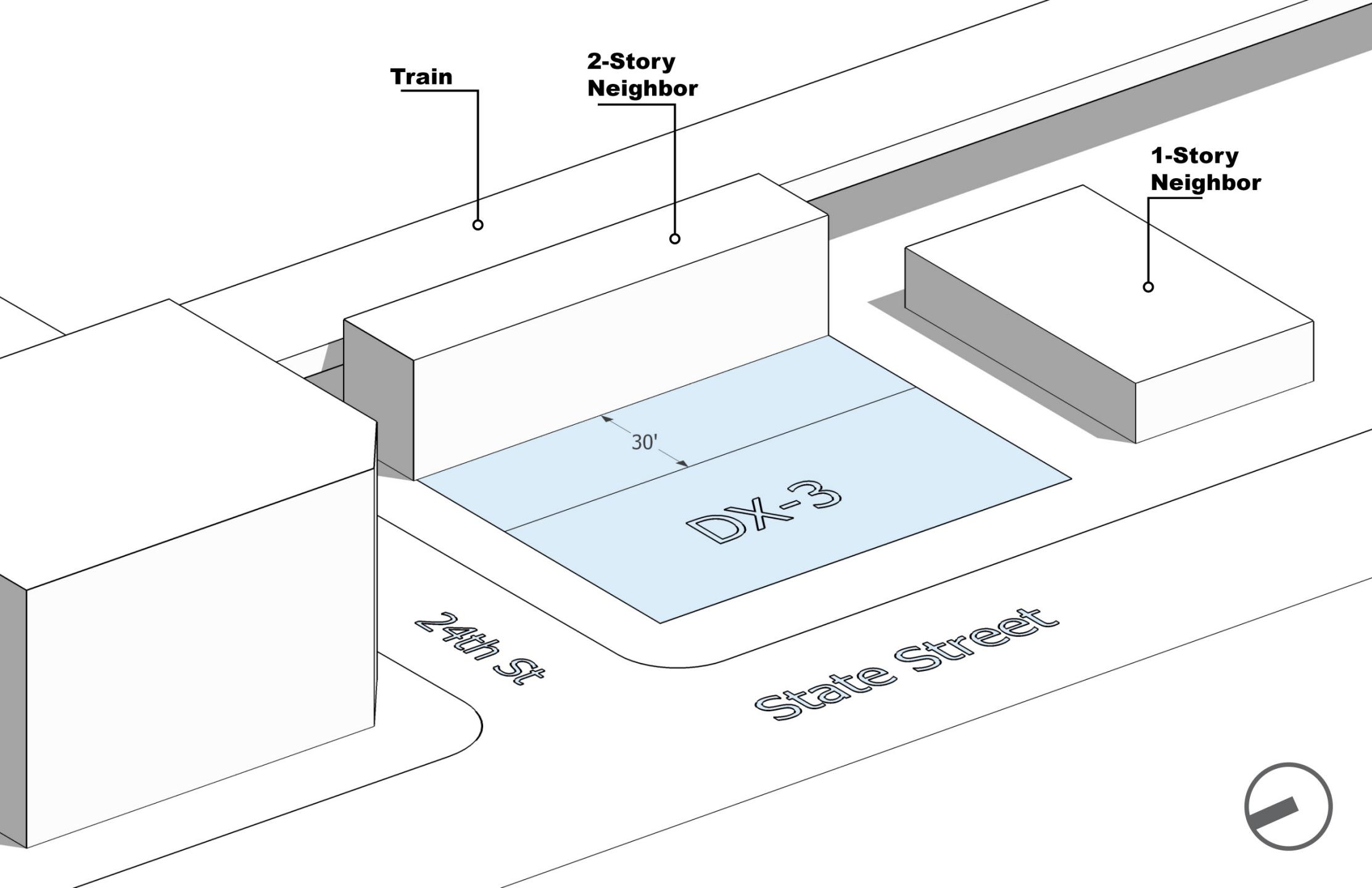


Household Type

**Need for Grocery Store and Coffee Shop**

Surrounding Building Types





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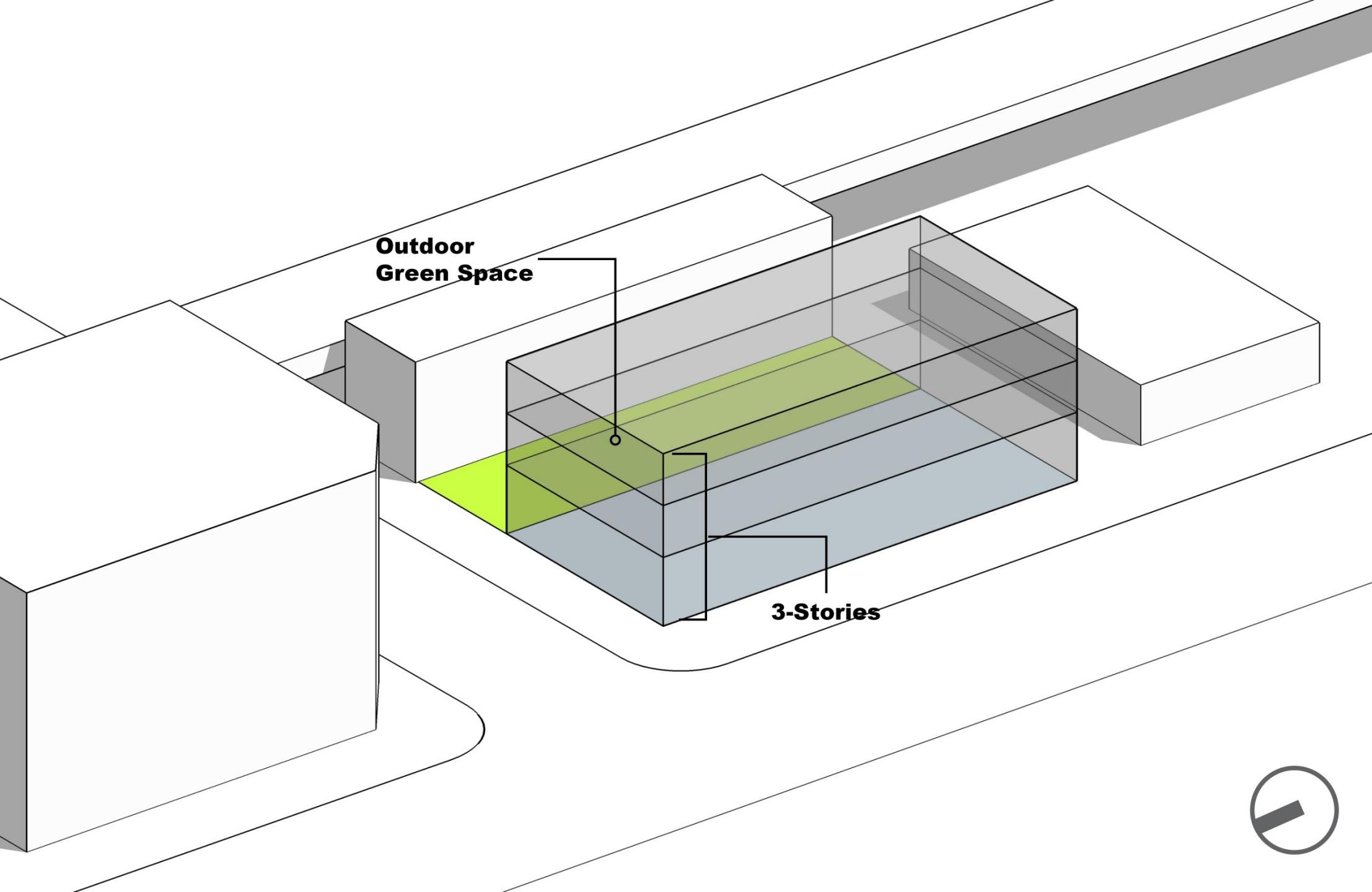
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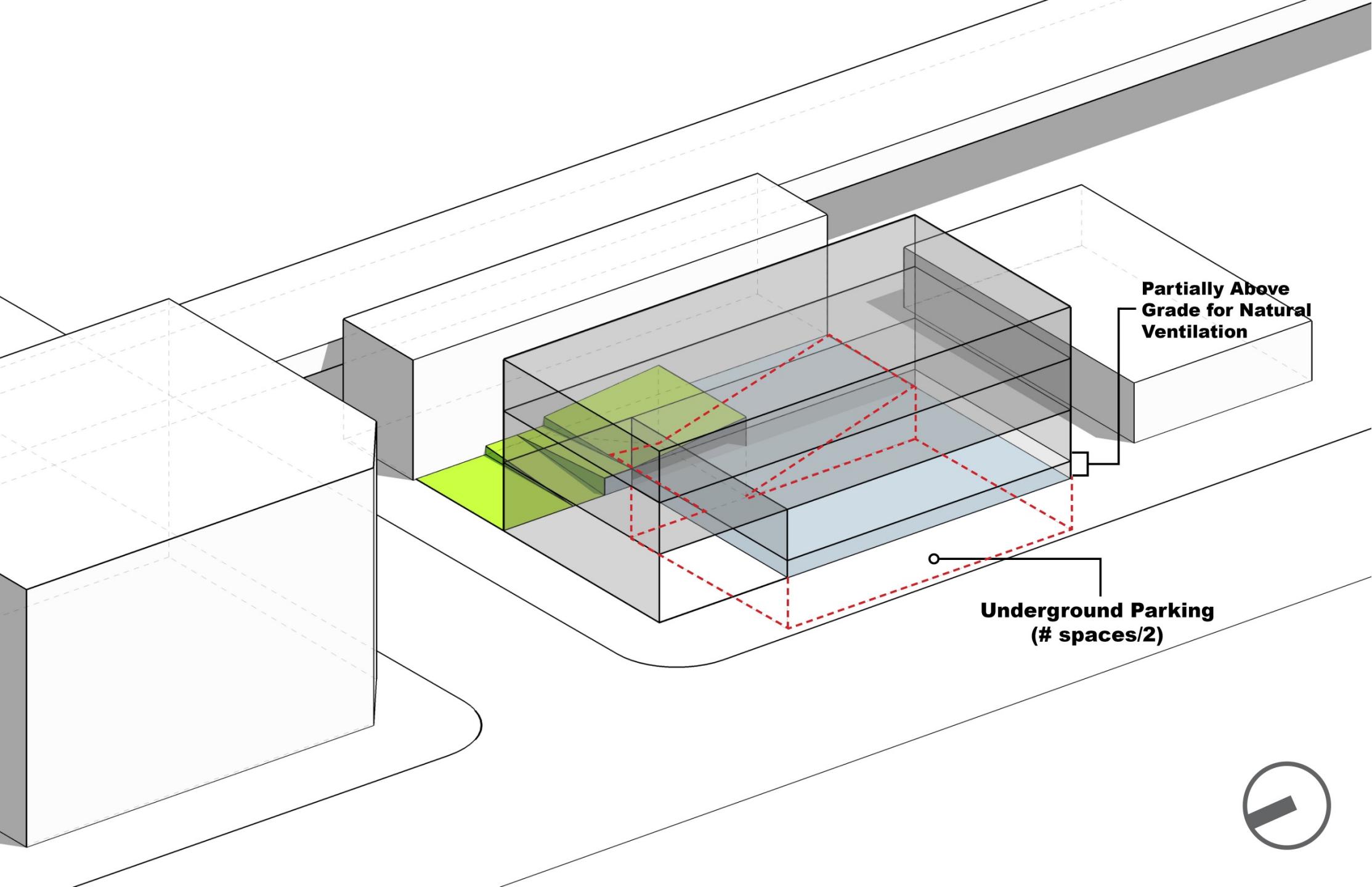
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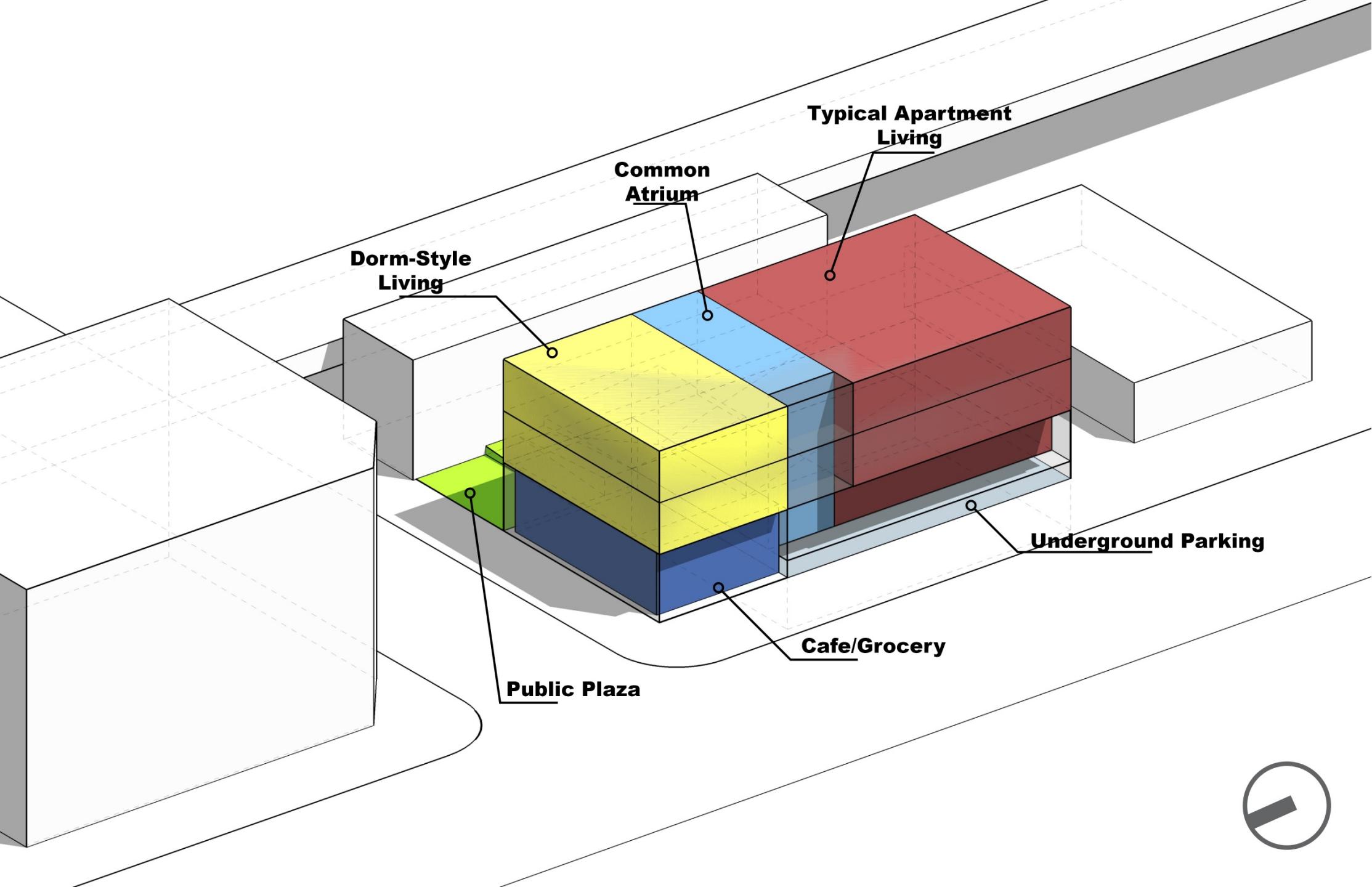
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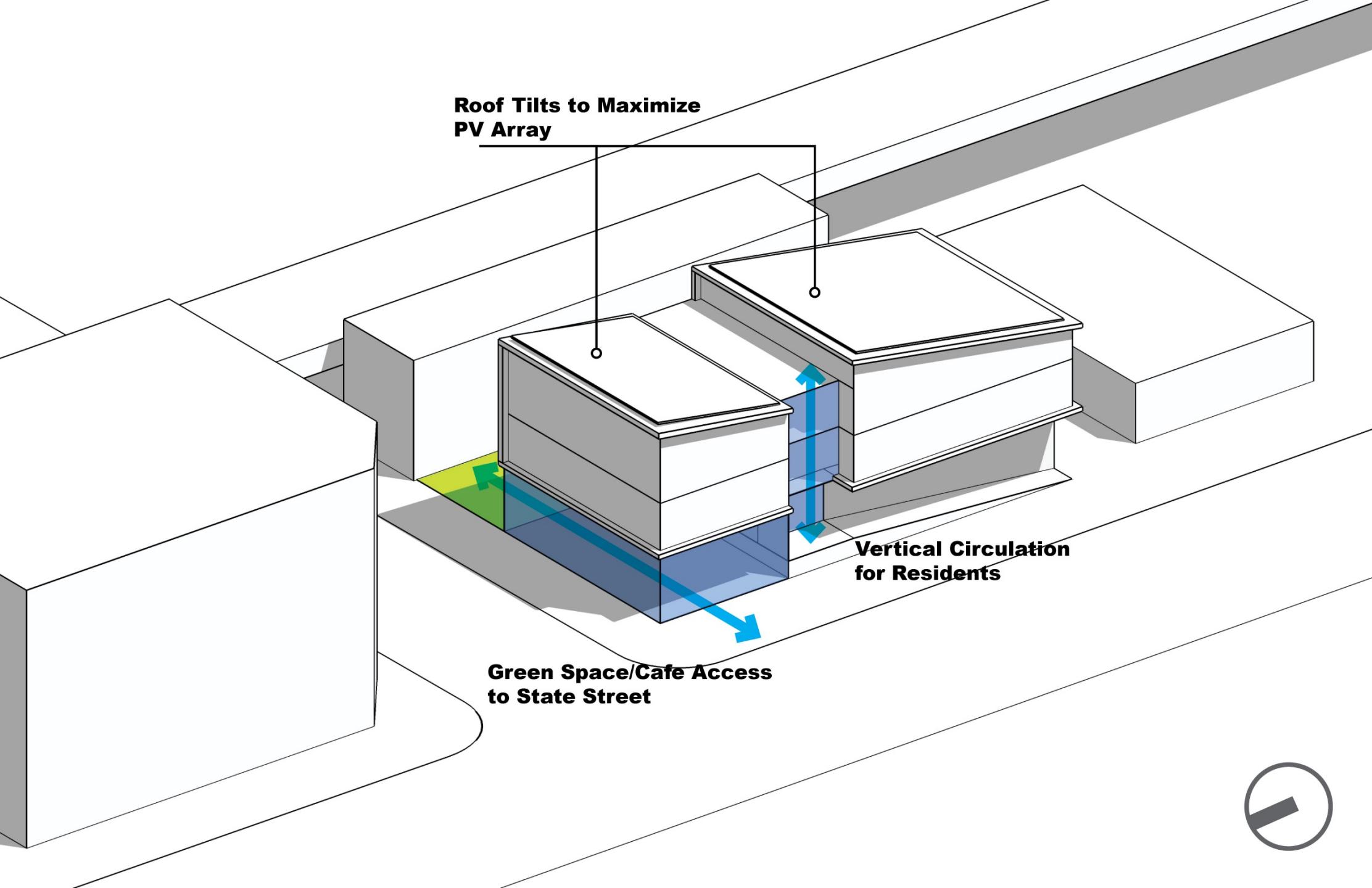
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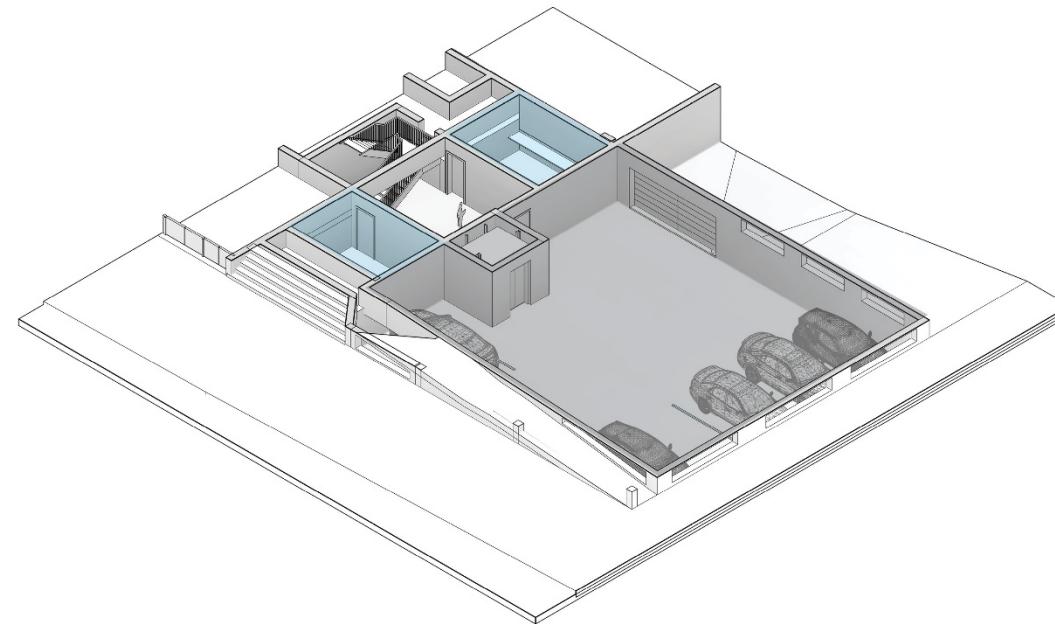
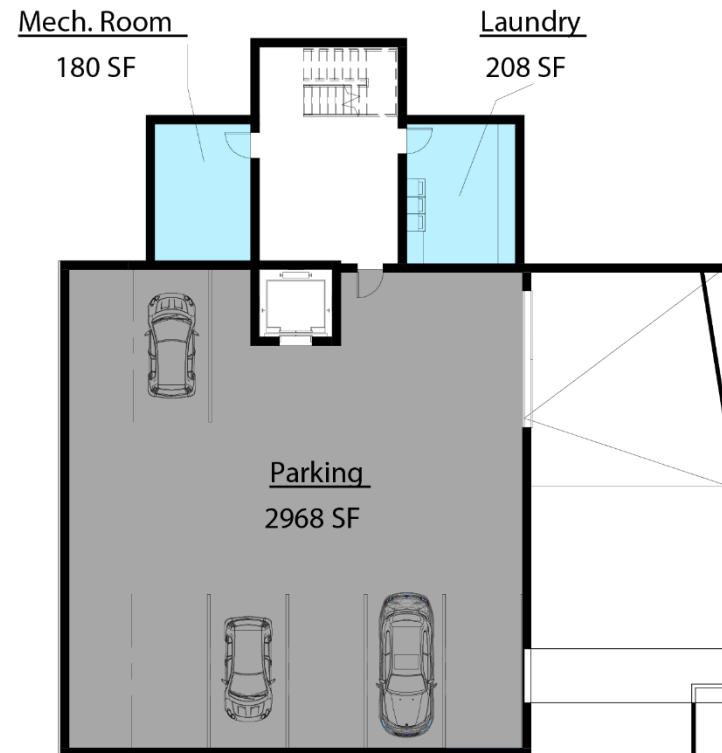
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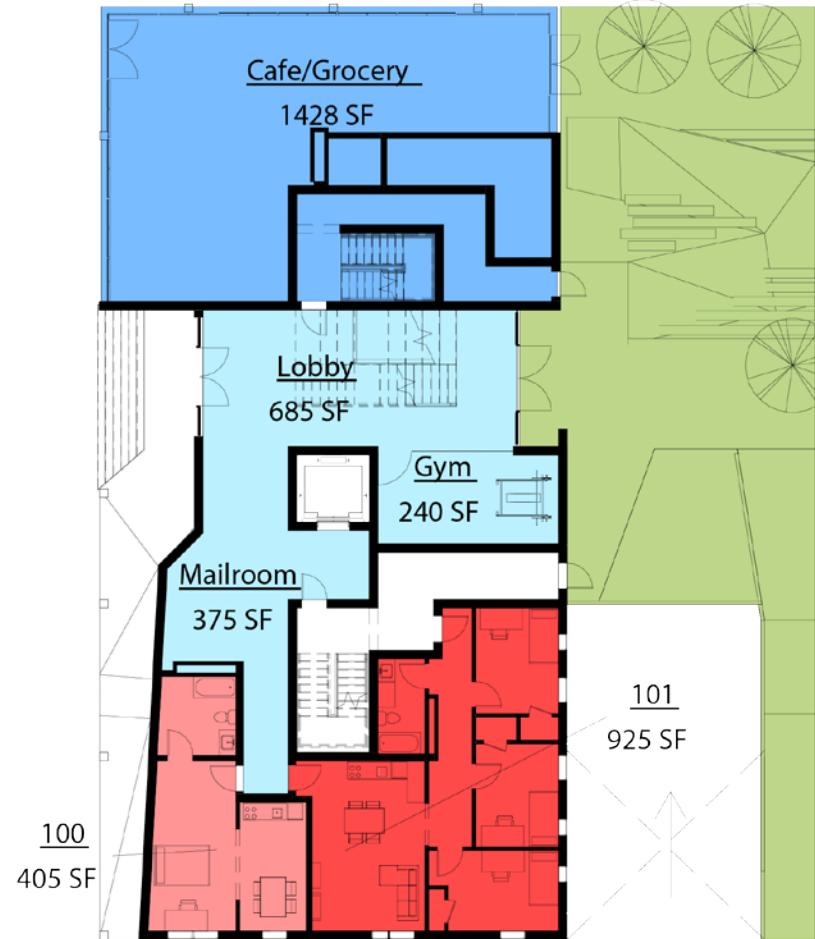


Basement

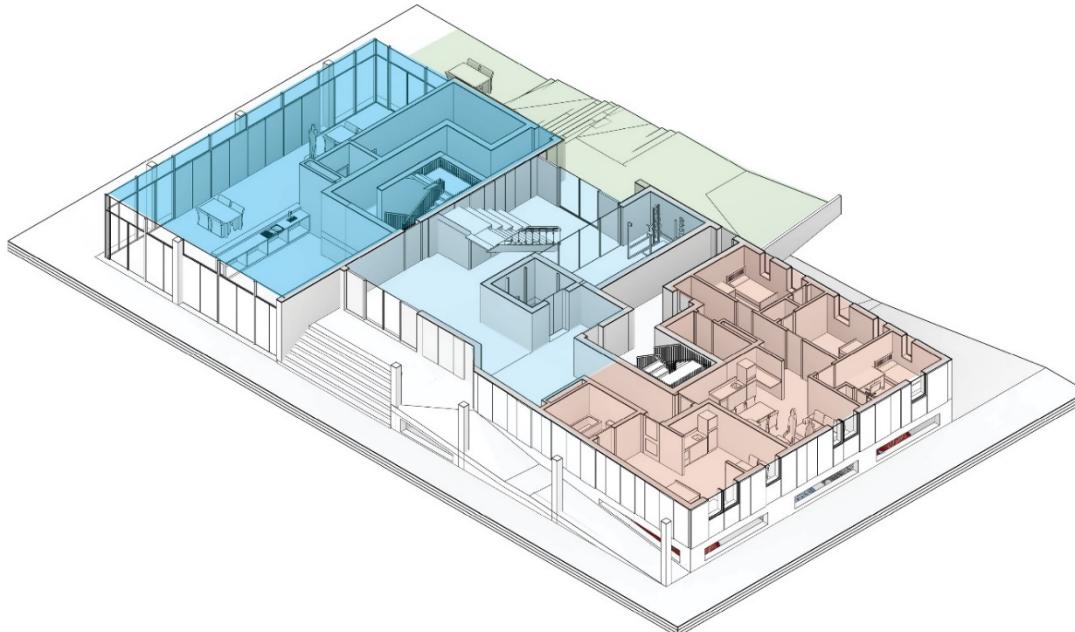


Basement

First Floor



First Floor



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Second Floor

Dorm West - 2DW

756 SF



Dorm East - 2DE

826 SF



200

360 SF

201

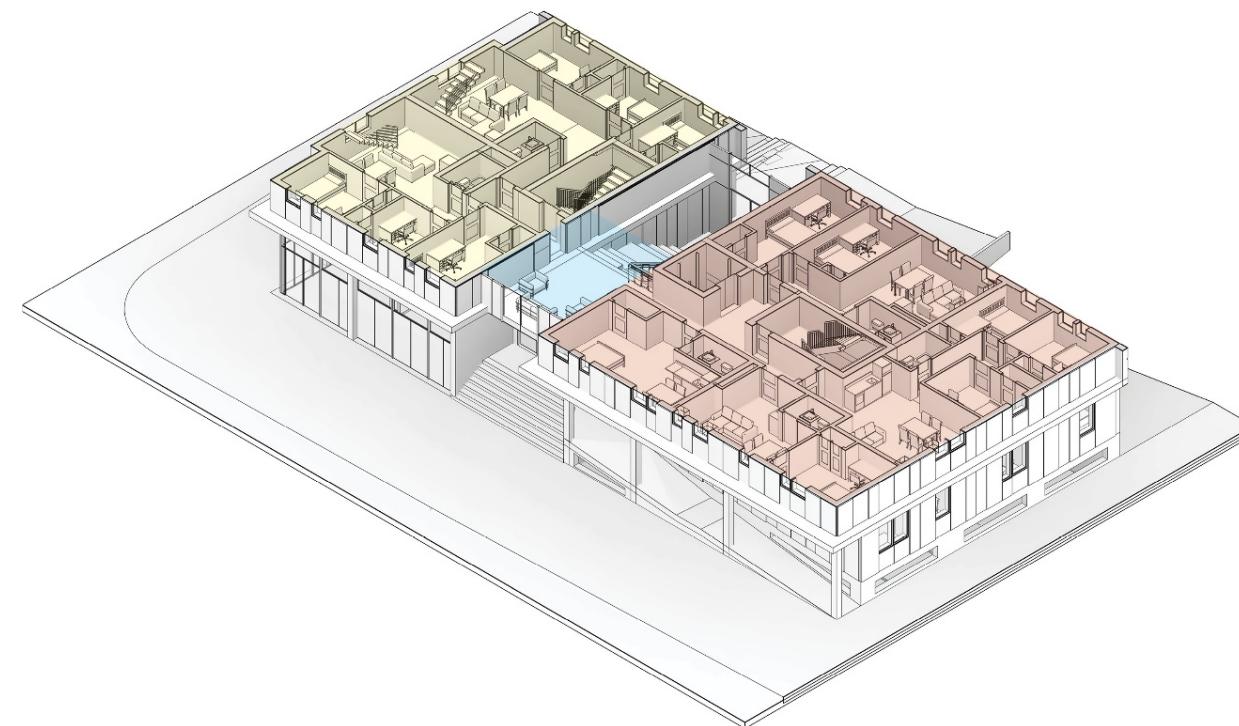
428 SF

202

747 SF

203

804 SF



Second Floor

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Third Floor

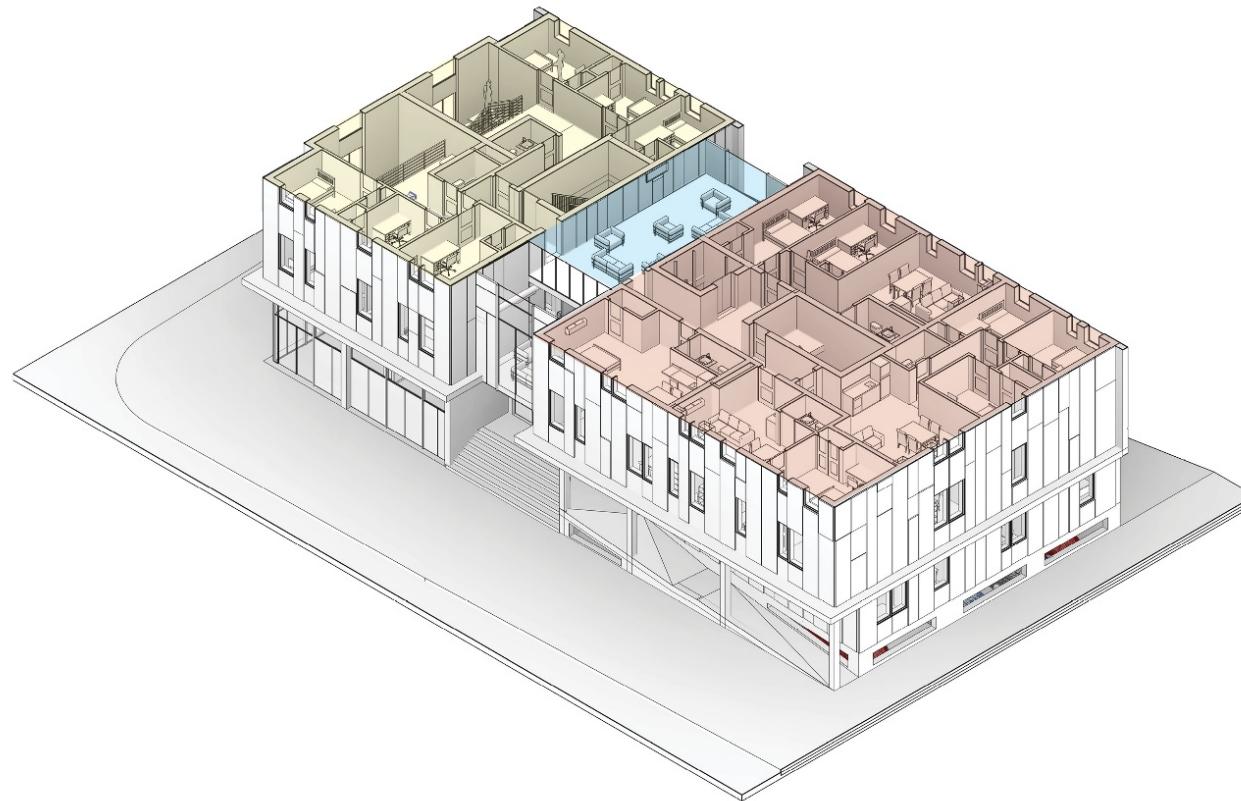
Dorm West - 3DW

601 SF



Dorm East - 3DE

672 SF



Third Floor

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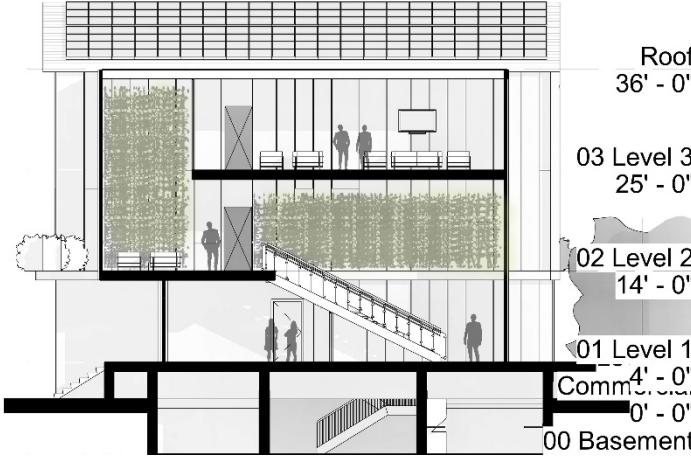
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Atrium Space



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Public Café and Plaza



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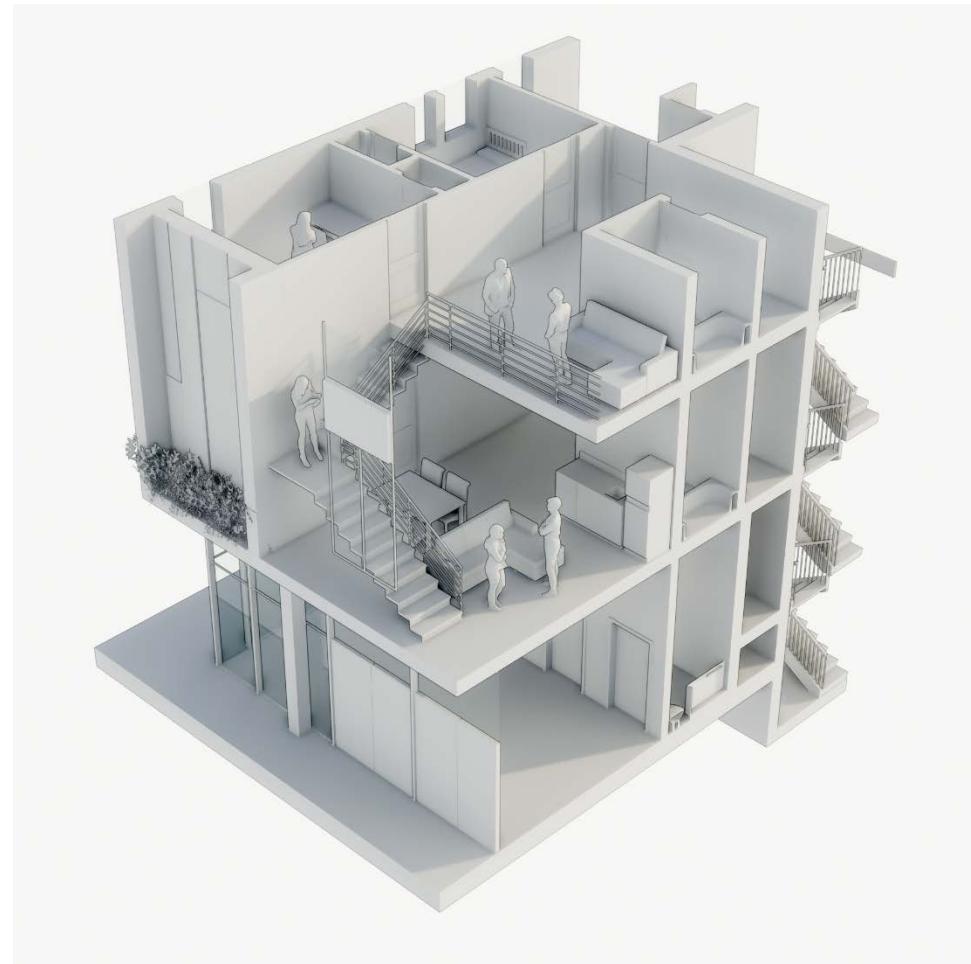
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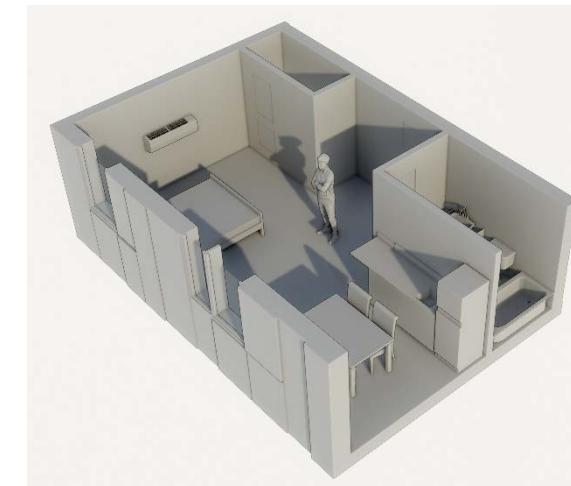
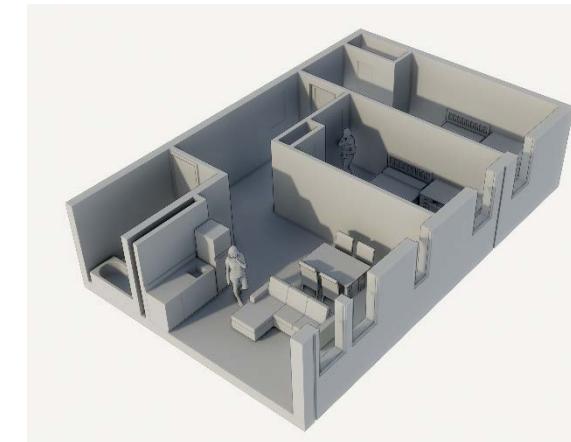
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Dorm-Style



Apartment-Style



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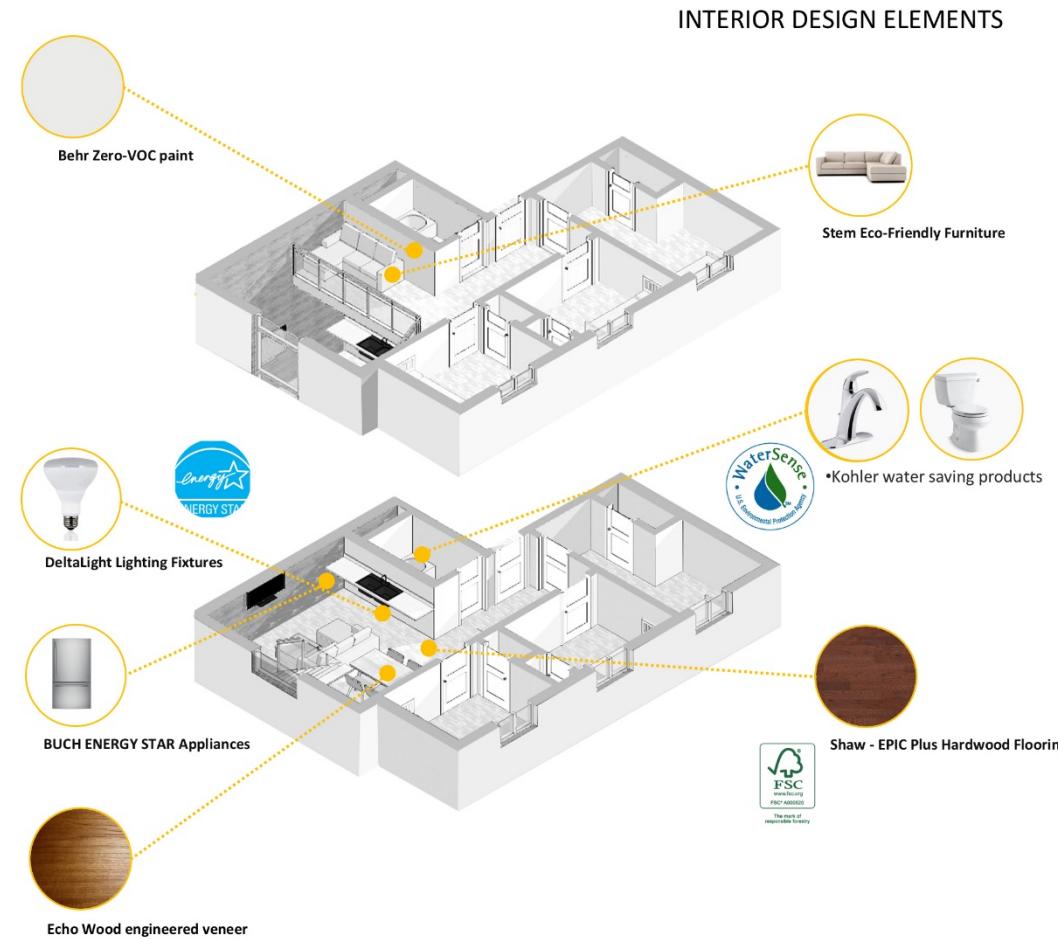
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Interior Finishes



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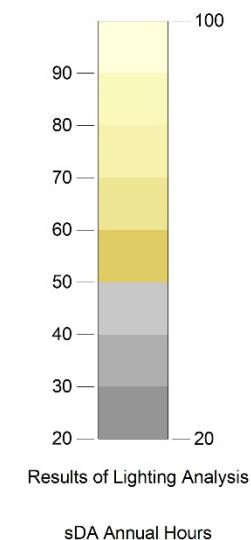
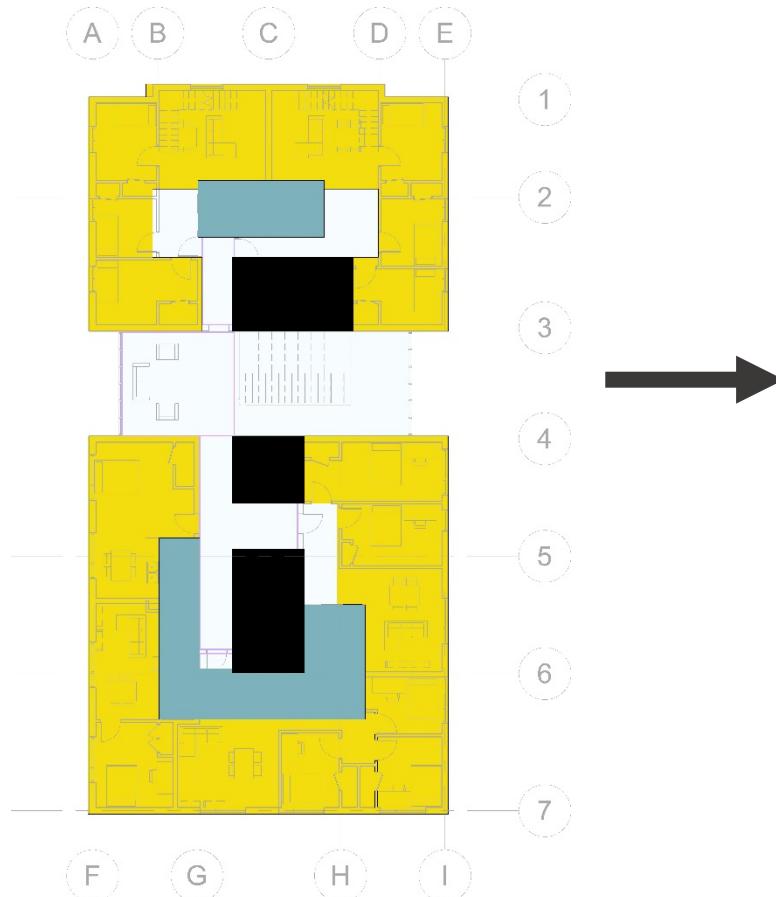
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Daylighting



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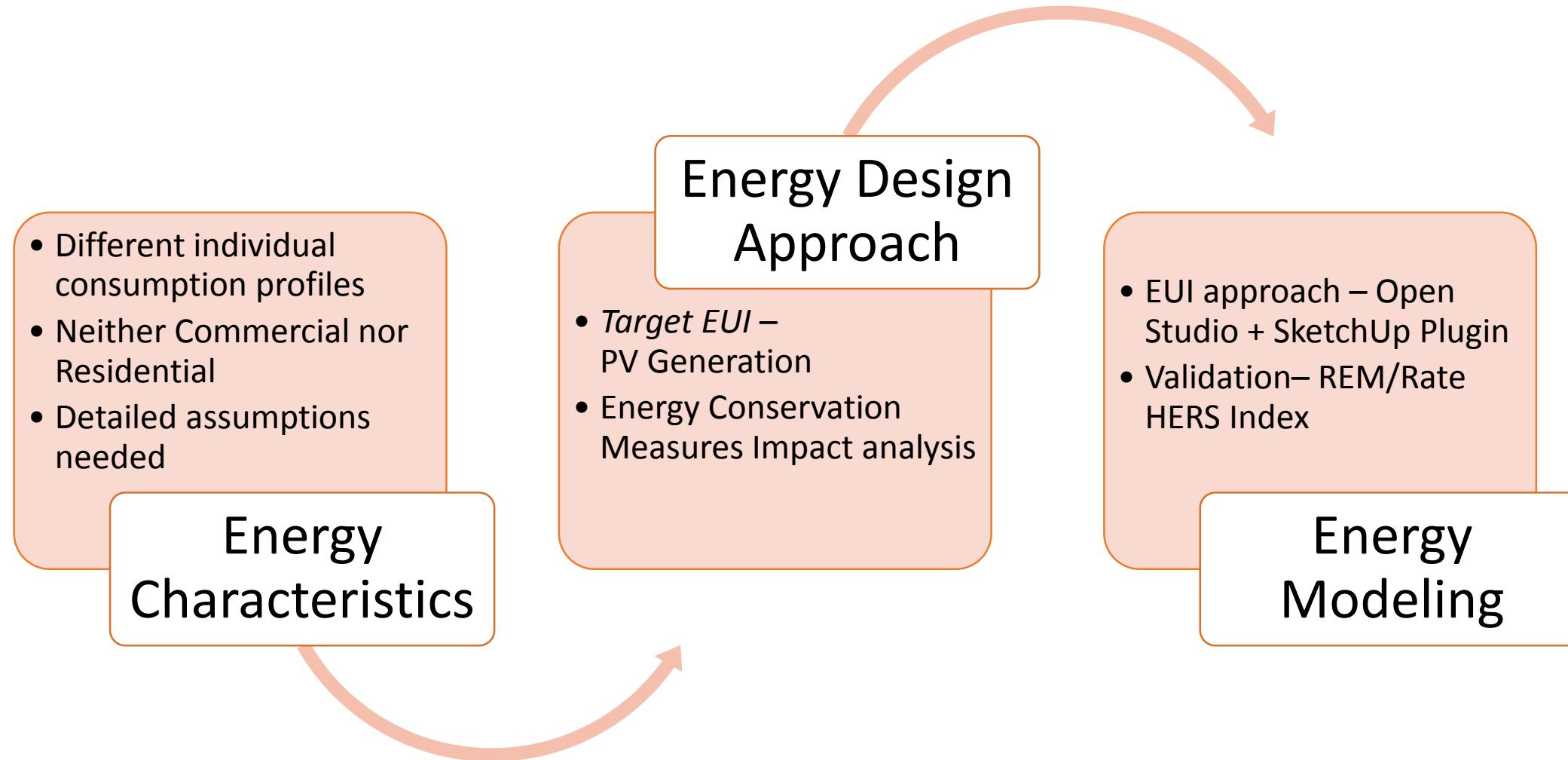
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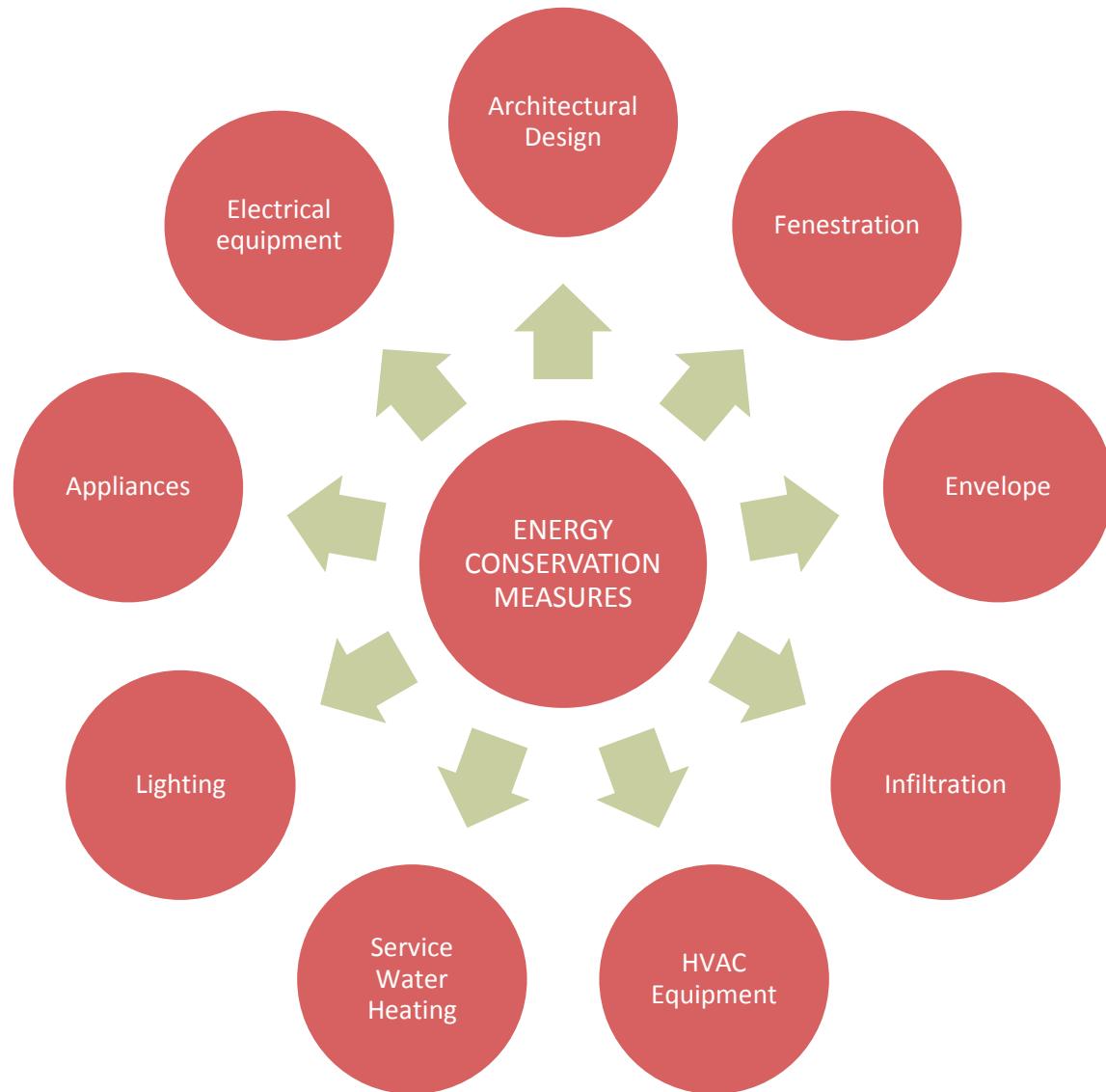
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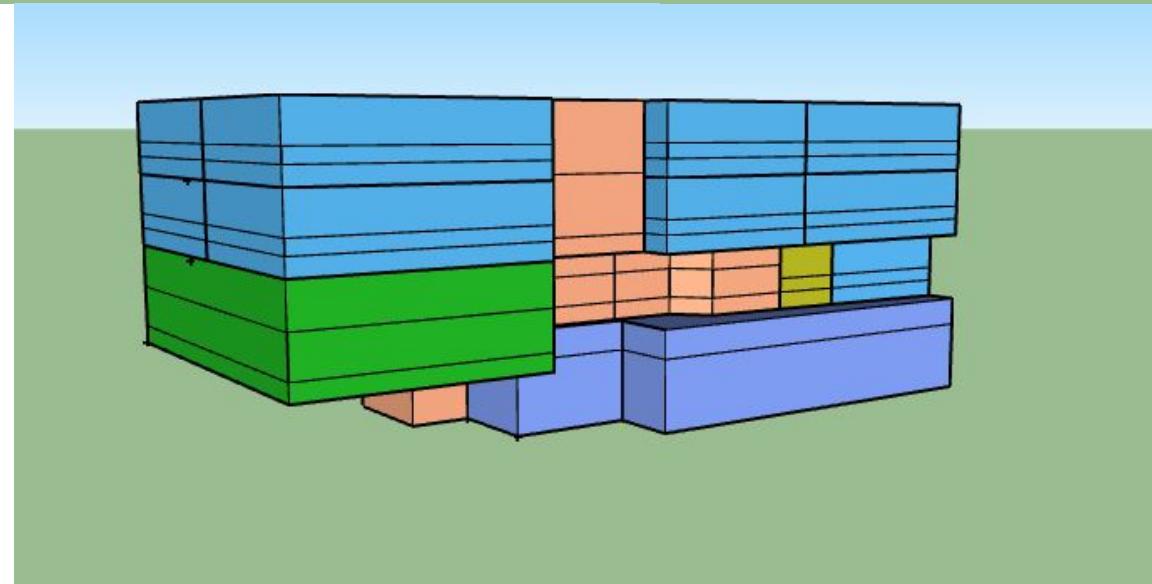
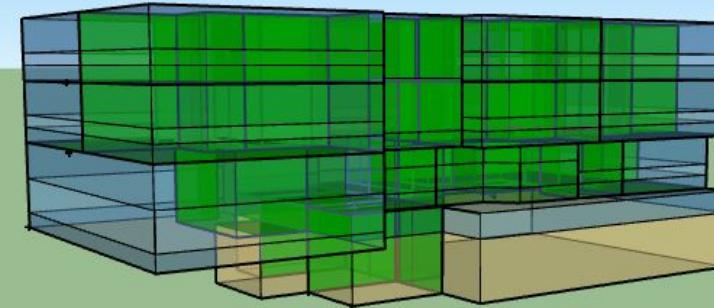
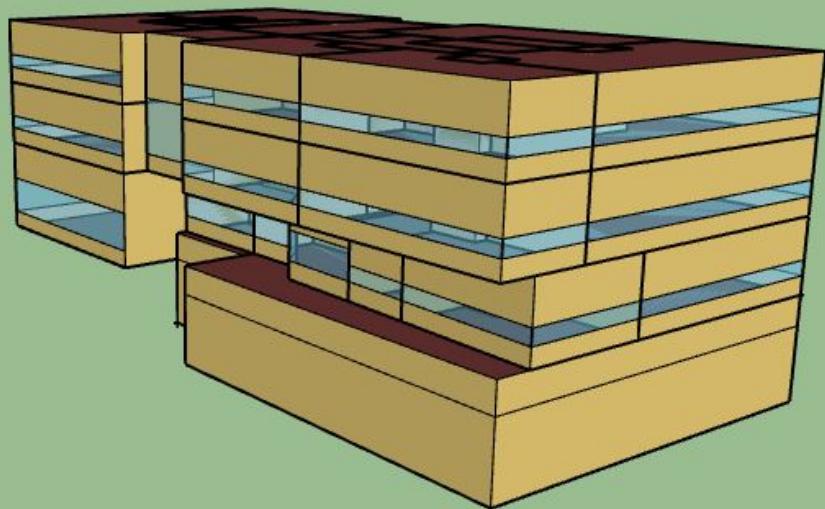
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SunPower® X22-360-C-AC | Residential AC Module Series

PV System Design Inputs

- Rooftop PV Gross Area: 5764 ft²
- Rooftop Usage Percentage: 83%
- Roof natural tilt: 10 degrees
- Relative Roof to Module Tilt: 0 degrees
- Total system Losses: 20%
- Module efficiency: 22%

SunPower, SAM and Lidar



272 PV Modules

98 kW_{dc} System Size

Cost of \$437,000

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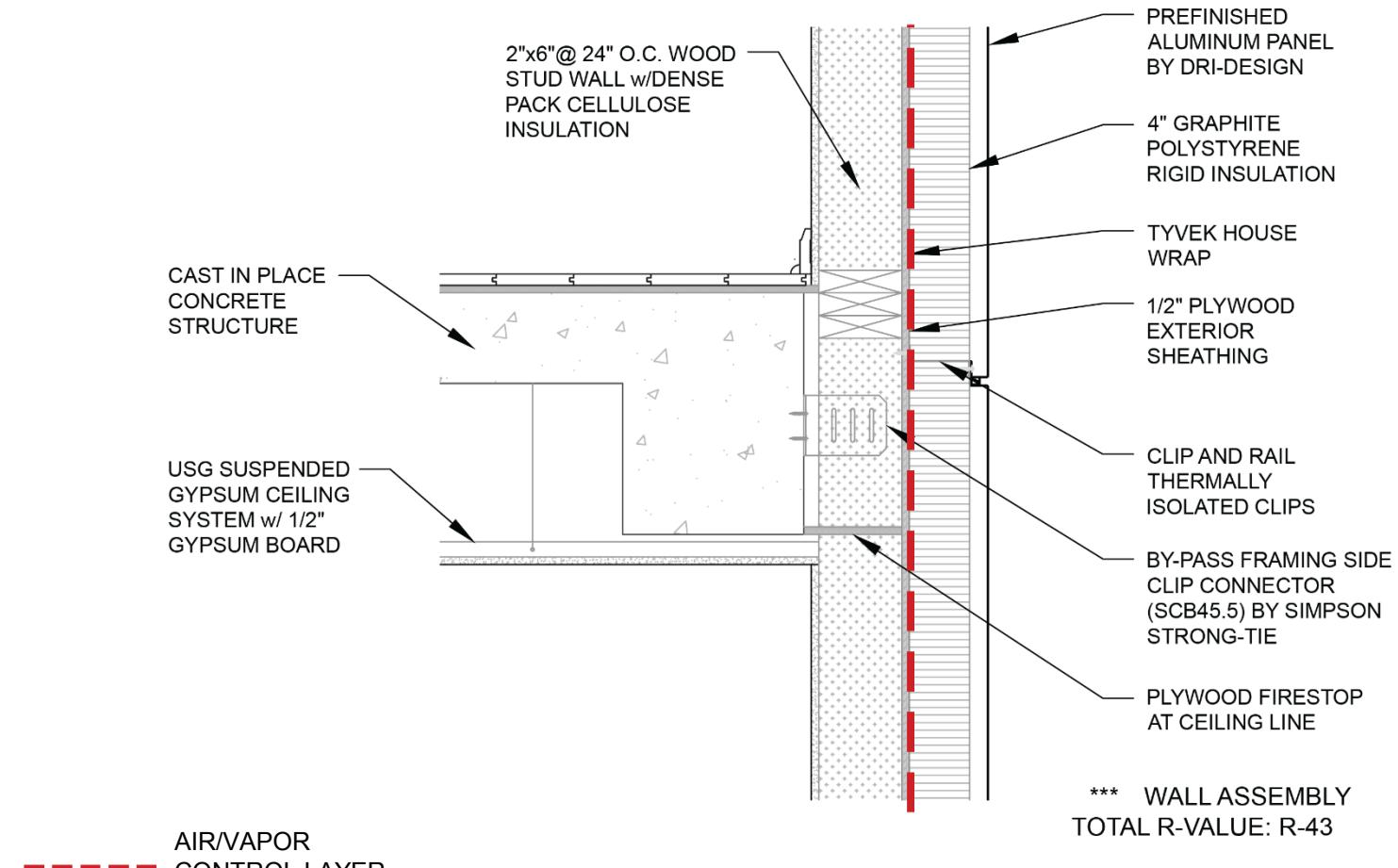
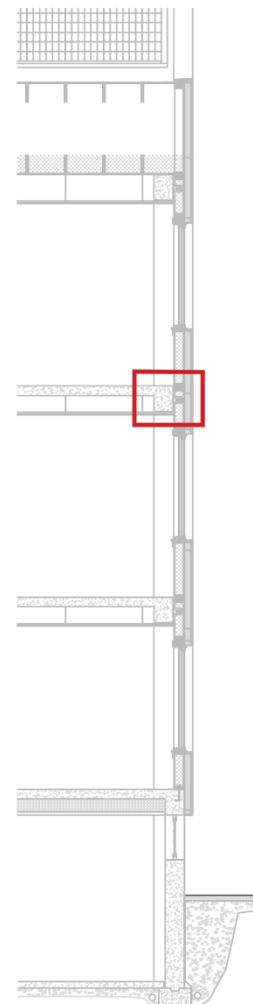
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FLOOR/WALL ASSEMBLY DETAIL

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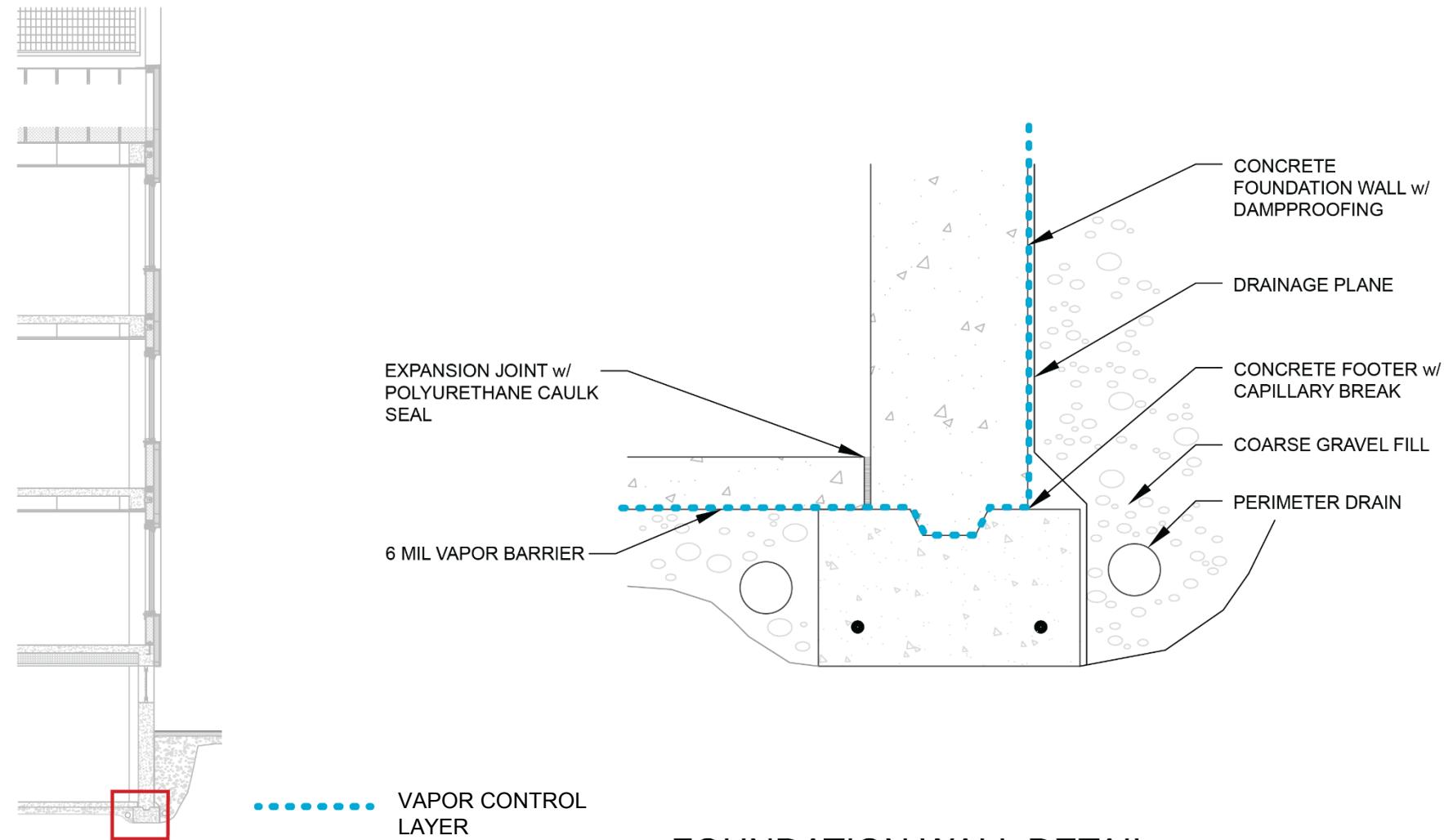
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FOUNDATION WALL DETAIL

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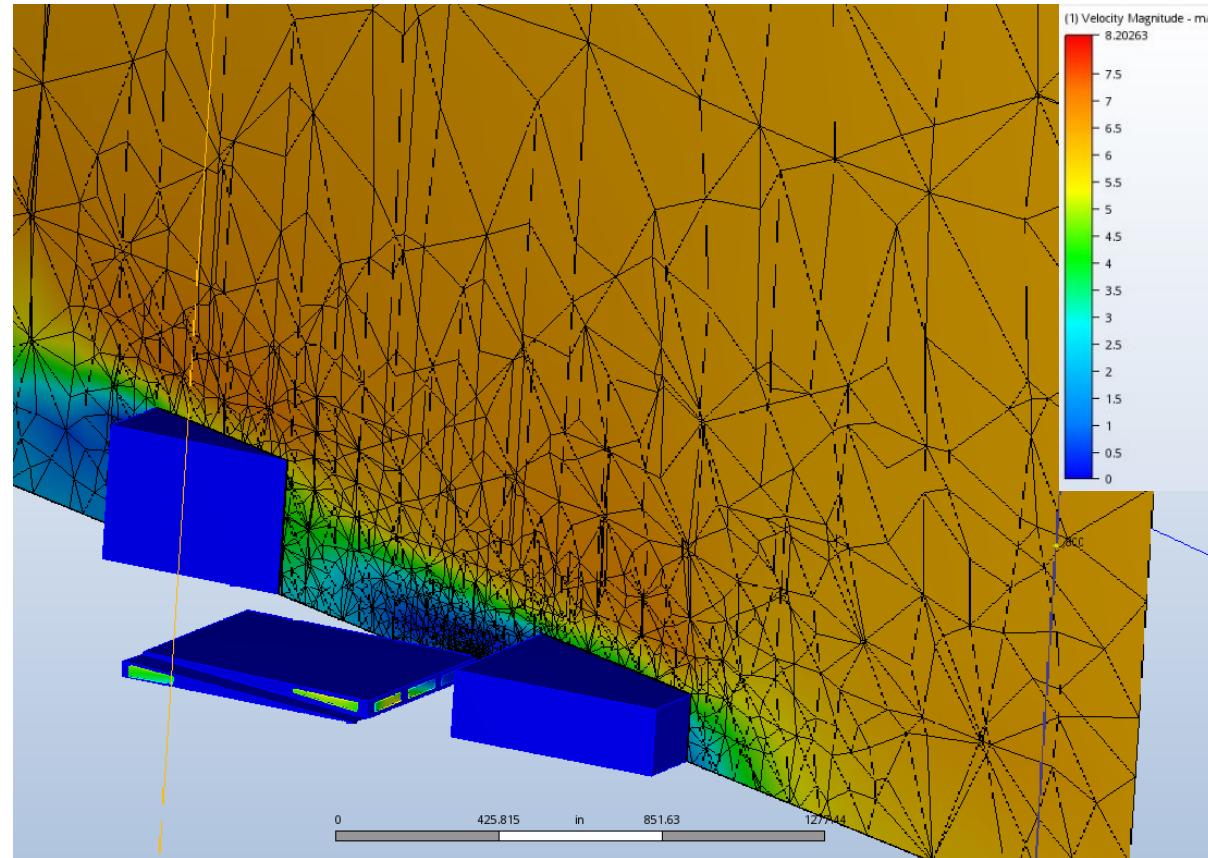
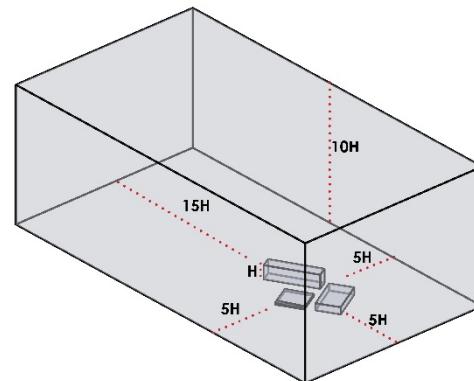
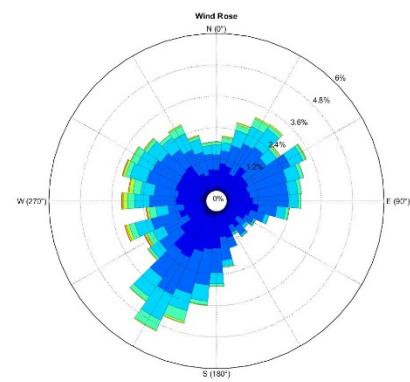
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Natural Ventilation for Underground Parking

Exterior Environment Simulation



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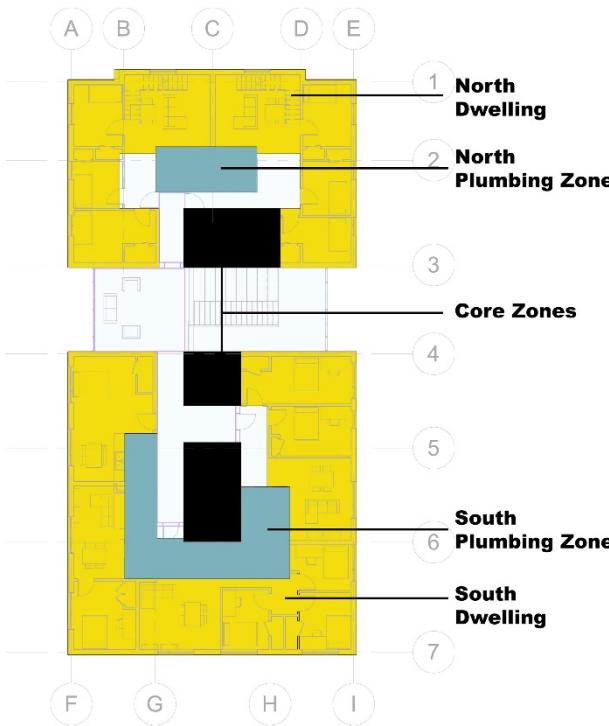
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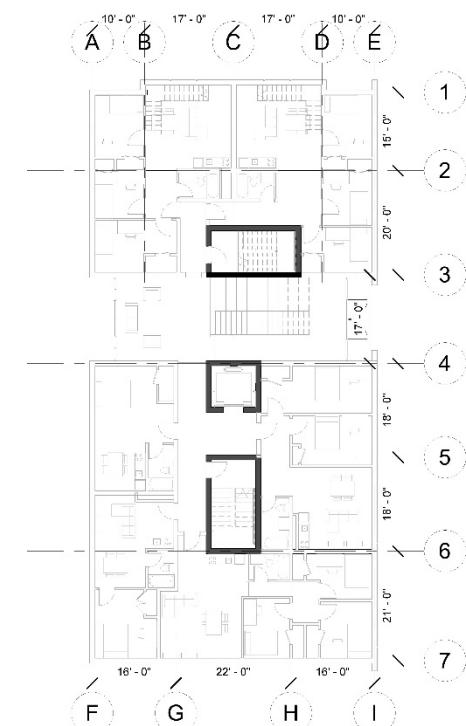
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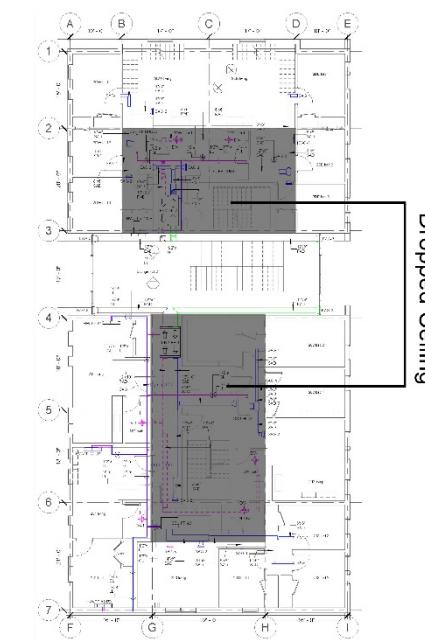
Parti



Structure



Dropped Ceilings



Daylighting



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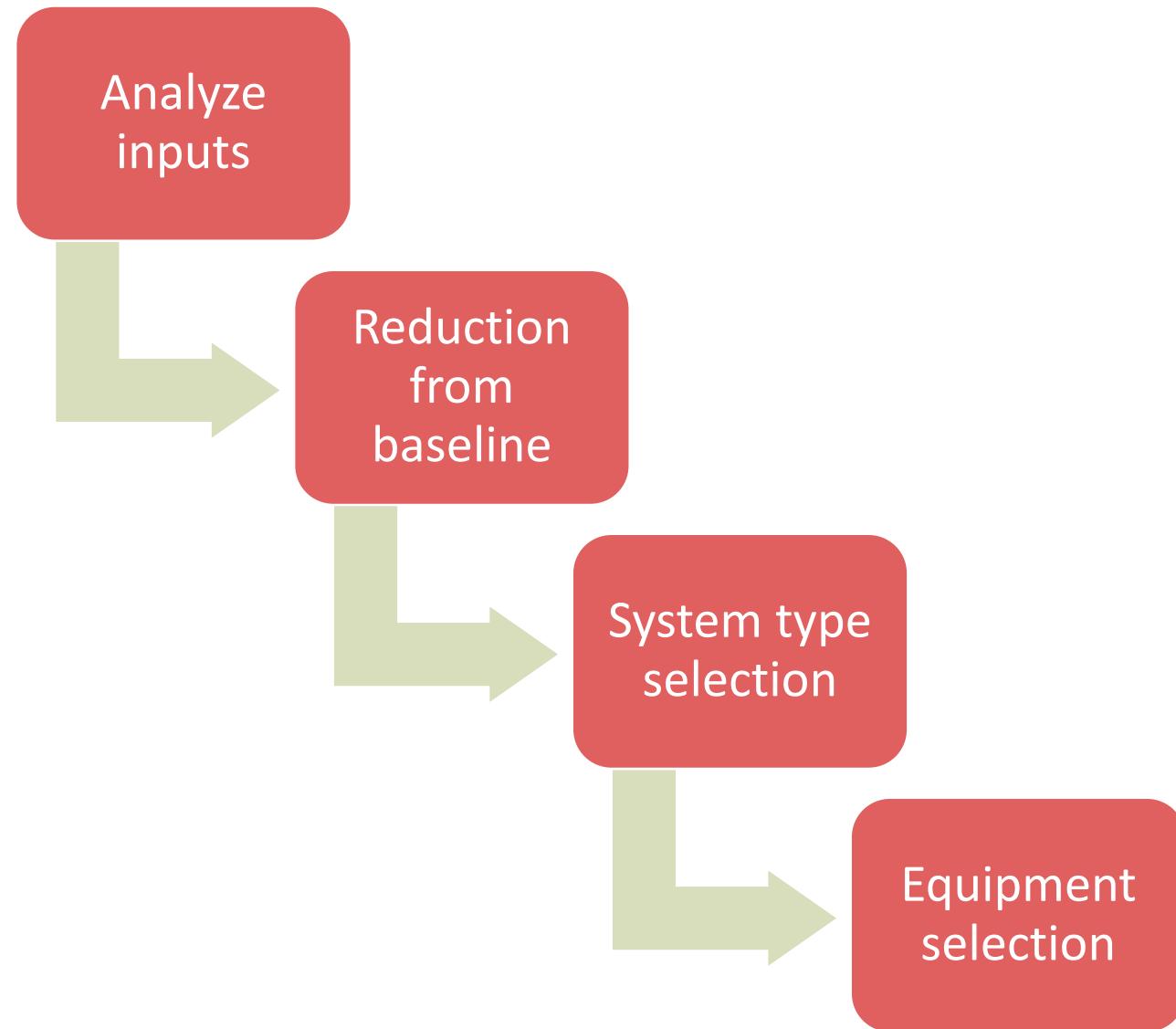
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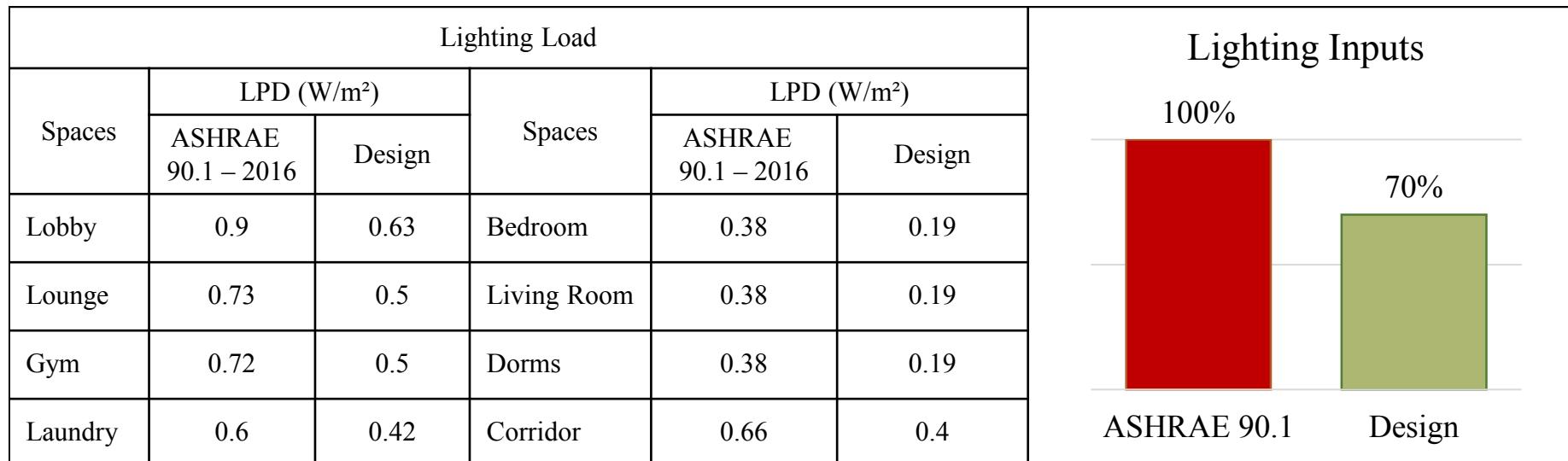
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| Building Thermal Properties | | | Building Envelope Inputs | |
|-----------------------------|------------------|-------------|--------------------------|--------|
| Element | ASHRAE 90.1 (IP) | Design (IP) | 100% | 50% |
| Glazing | U-0.42 | U-0.27 | | |
| External Wall | R-13 | R-30 | | |
| Partition Wall | - | R-2 | | |
| Roof | R-20 | R-40 | | |
| Shading Coefficient | 0.4 | 0.25 | ASHRAE 90.1 | Design |



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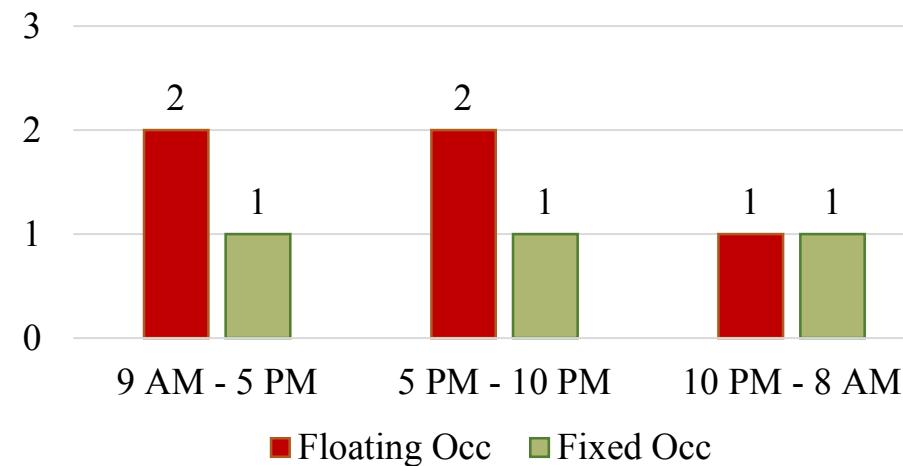
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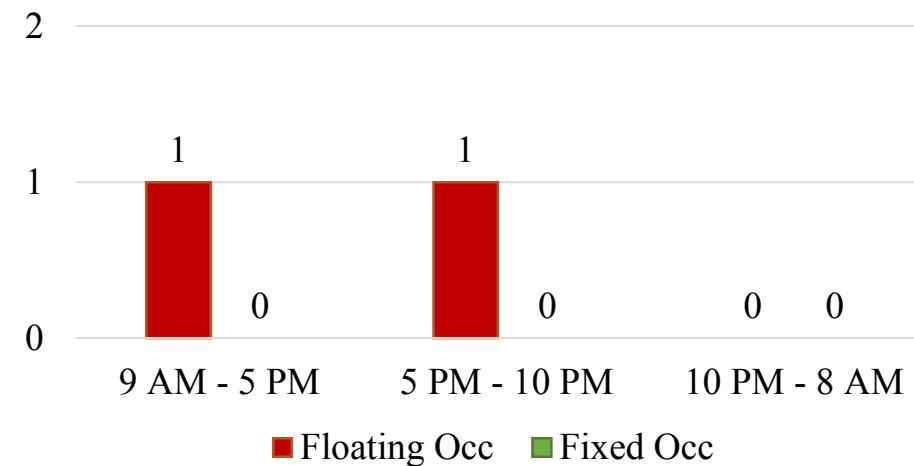
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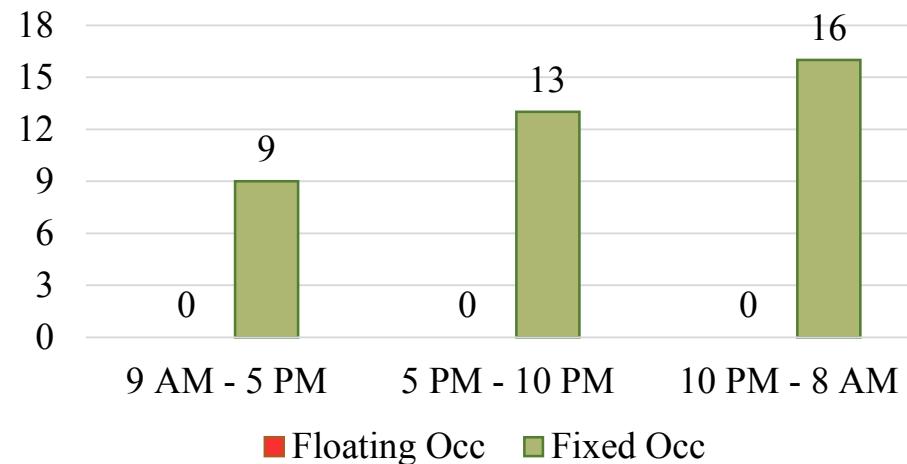
Lobby



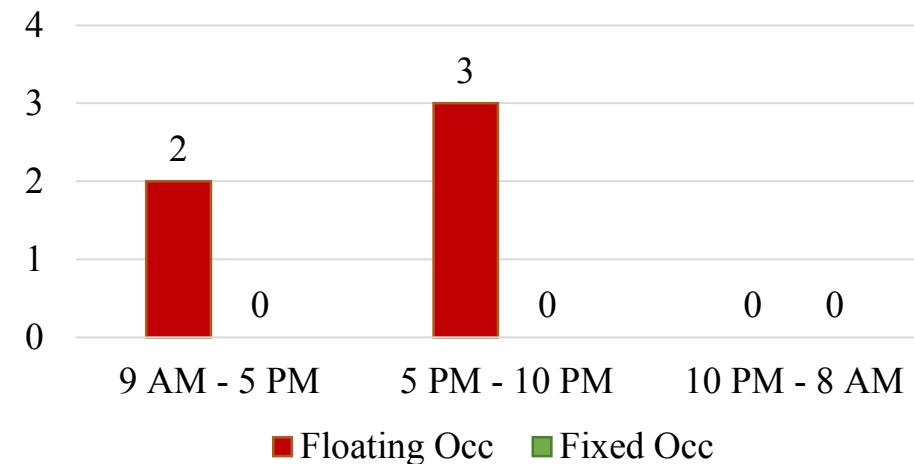
Laundry



Dwelling Unit



Lounge/Plaza



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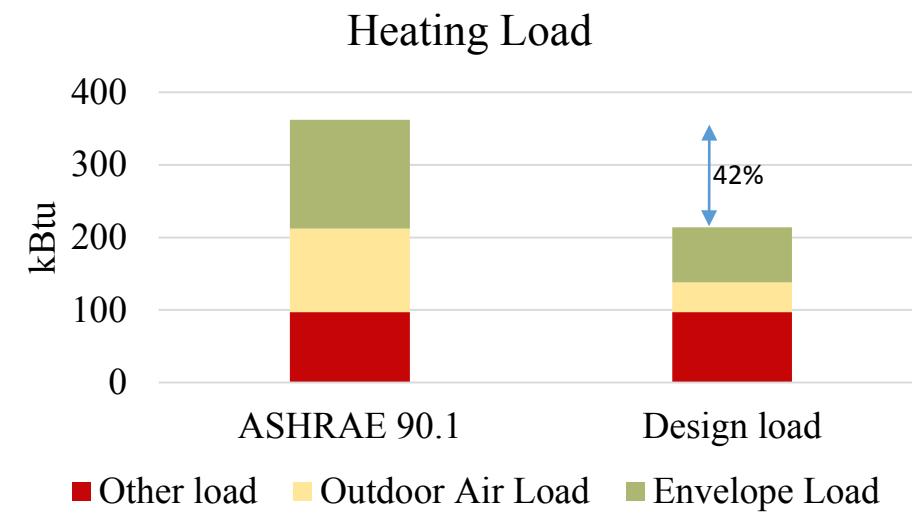
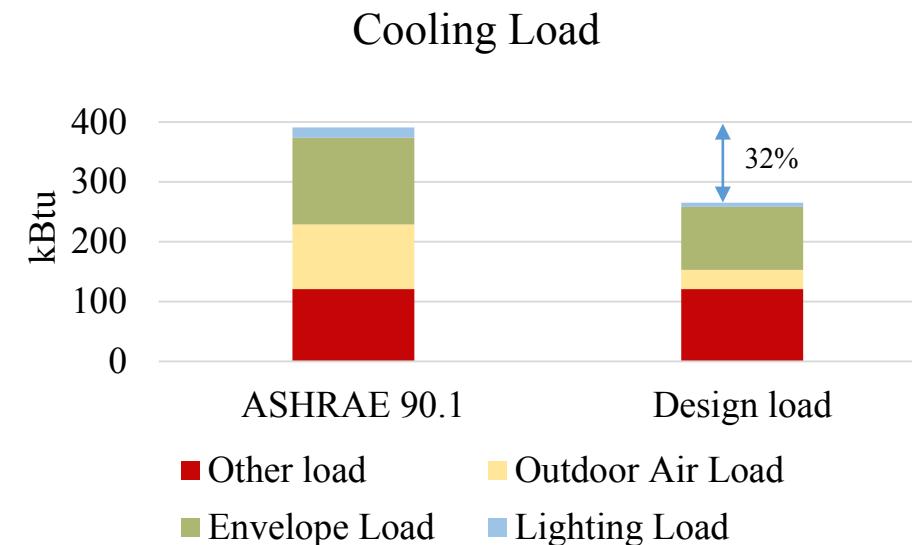
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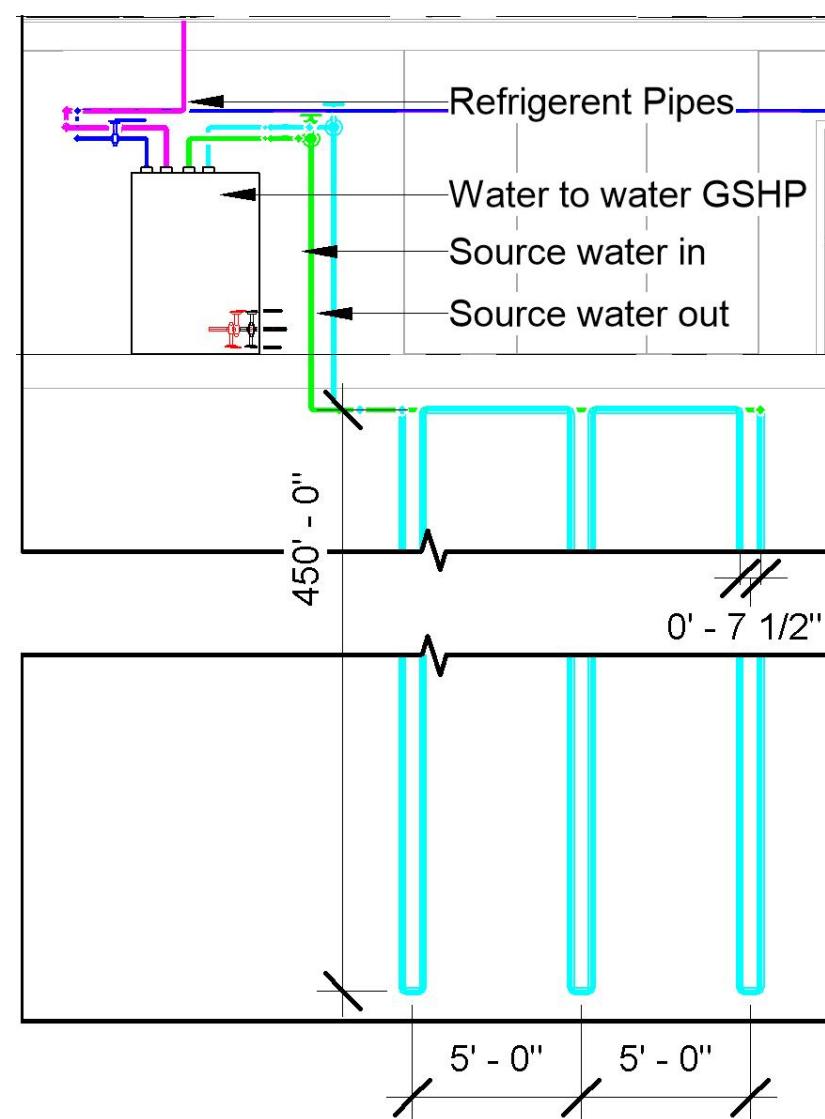
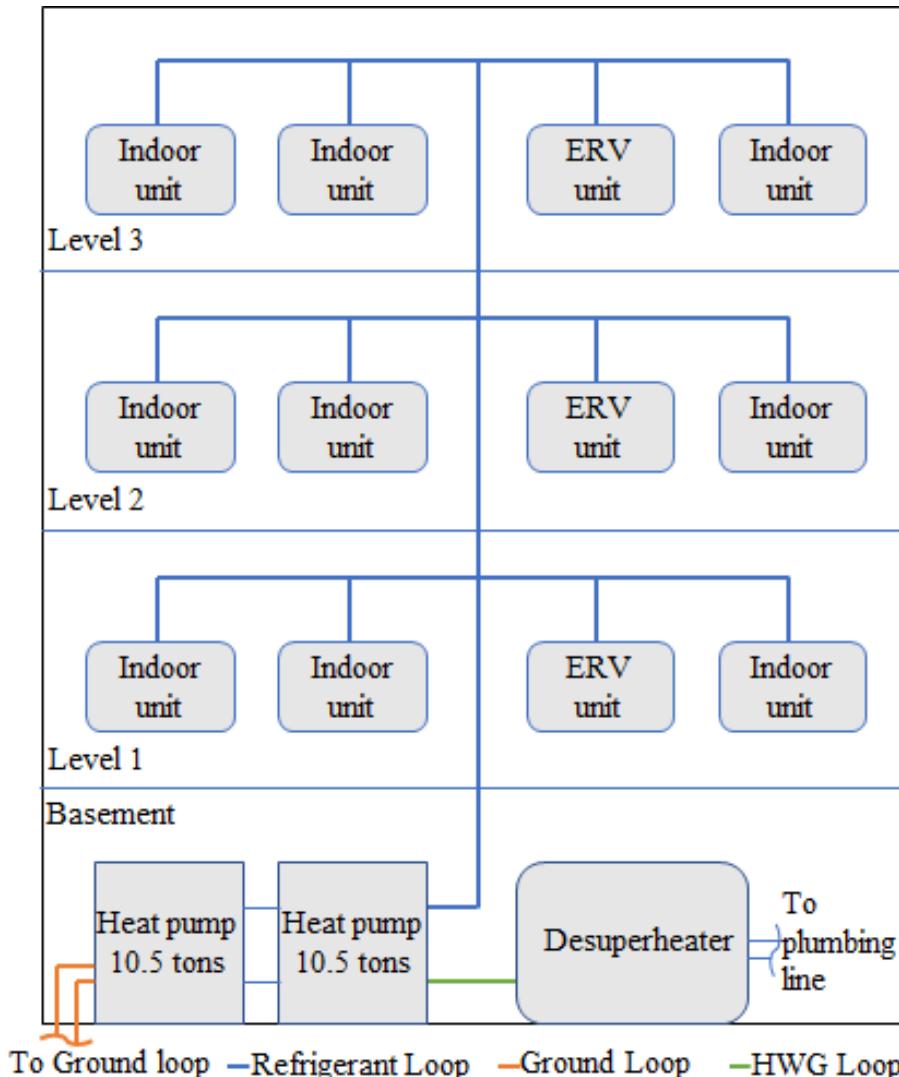
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| Cooling Load Reduction Summary | | |
|--------------------------------|-----------------------------------|------------|
| Sl. No. | Key Factors | Tons |
| 1 | Due to Energy Recovery Unit | 7 |
| 2 | Due to effective facade design | 3 |
| 3 | Due to reduction in lighting load | 1 |
| Total Reduction | | 11 |
| % Reduction | | 32% |

| Heating Load Reduction Summary | | |
|--------------------------------|--------------------------------|------------|
| Sl. No. | Key Factors | kbtu/h |
| 1 | Due to Heat Recovery Unit | 75 |
| 2 | Due to effective facade design | 73 |
| Total Reduction | | 148 |
| % Reduction | | 42% |



Geothermal system design



Level 1
4' - 0"



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Basement
-6' - 0"



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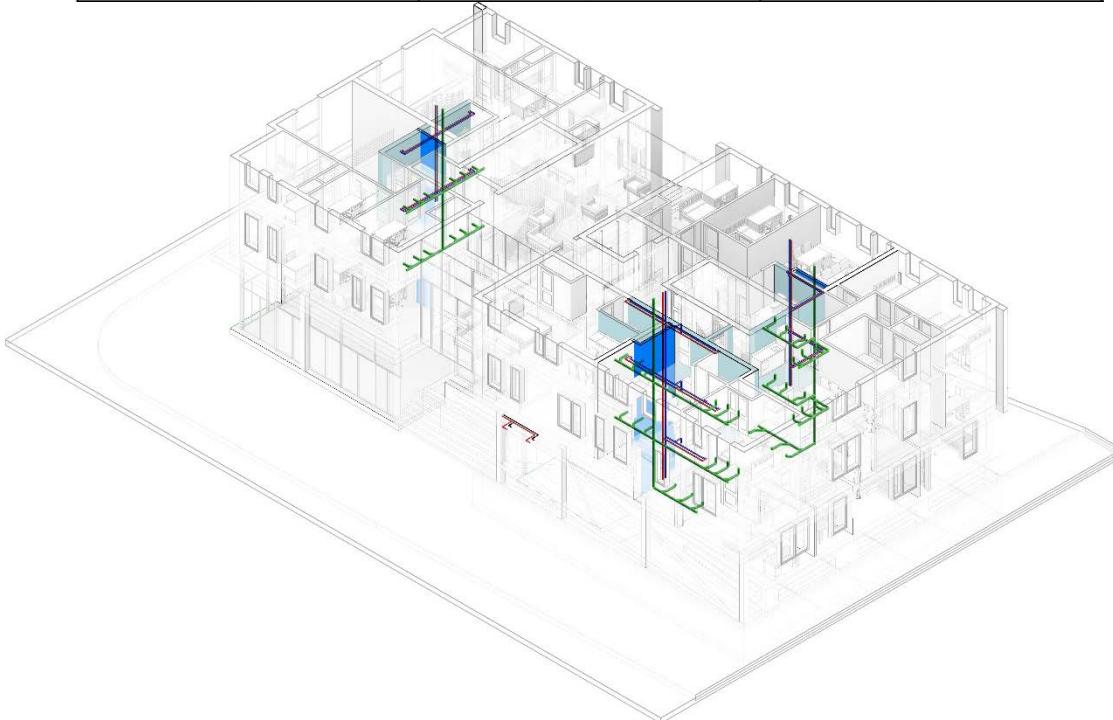
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Plumbing Design

| RISER 1 | Longitude vertical pipe (ft) | Hot Water | | Cold Water | |
|--------------|------------------------------|-------------|------------|-------------|------------|
| | | Size (inch) | Flow (gpm) | Size (inch) | Flow (gpm) |
| Third floor | 11.00 | 1" | 8.00 | 1 1/4" | 11 |
| Second floor | 11.00 | 1 1/2" | 15.00 | 2" | 20 |
| First floor | 13.50 | 1 1/2" | 15.00 | 2" | 20 |
| Basement | 4.00 | 2" | 19.00 | 2" | 23.5 |

| RISER 2 AND 3 | Longitude vertical pipe (ft) | Hot Water | | Cold Water | |
|---------------|------------------------------|-------------|------------|-------------|------------|
| | | Size (inch) | Flow (gpm) | Size (inch) | Flow (gpm) |
| Third floor | 11.00 | 1" | 8 | 1 1/4 " | 11 |
| Second floor | 11.00 | 1 1/2" | 15 | 2" | 20 |
| First floor | 13.50 | 1 1/2" | 16 | 2" | 22 |
| Basement | 4.00 | 1 1/2" | 16 | 2" | 22 |



Demand-Initiated Recirculation

Water Sense Fixtures

Gas fired water heater: 38 gal

Desuperheater

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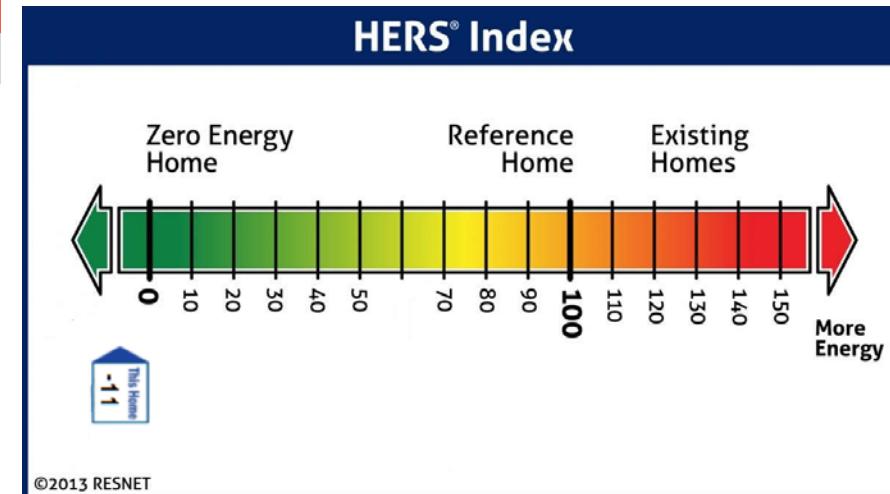
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InterTech's Energy Analysis

| | Open Studio Results | REM/Rate Results |
|-------------------------------------|---------------------|------------------|
| Annual Net Site Energy Consumptions | KBtu | kBtu |
| Heating | 26,027 | 32,700 |
| Cooling | 18,606 | 20,900 |
| Interior Lighting | 71,276 | |
| Exterior Lighting | 5,213 | 200,100 |
| Interior Equipment | 72,527 | |
| Fans | 15,658 | |
| Pumps | 3,175 | |
| Heat Recovery | 27,468 | |
| Water Systems | 47,192 | 59,100 |
| Total Net Site | 287,142 | 312,800 |
| Difference between models | | 8% |
| EUI (over conditioned space) | 26 | 28 |
| HERS Index | | (11) |



Detailed and validation modeling techniques validate Net Positive Objective

Design EUI: 26-28 kBtu/ft²

HERS Index: (-11) with PV,53 without PV

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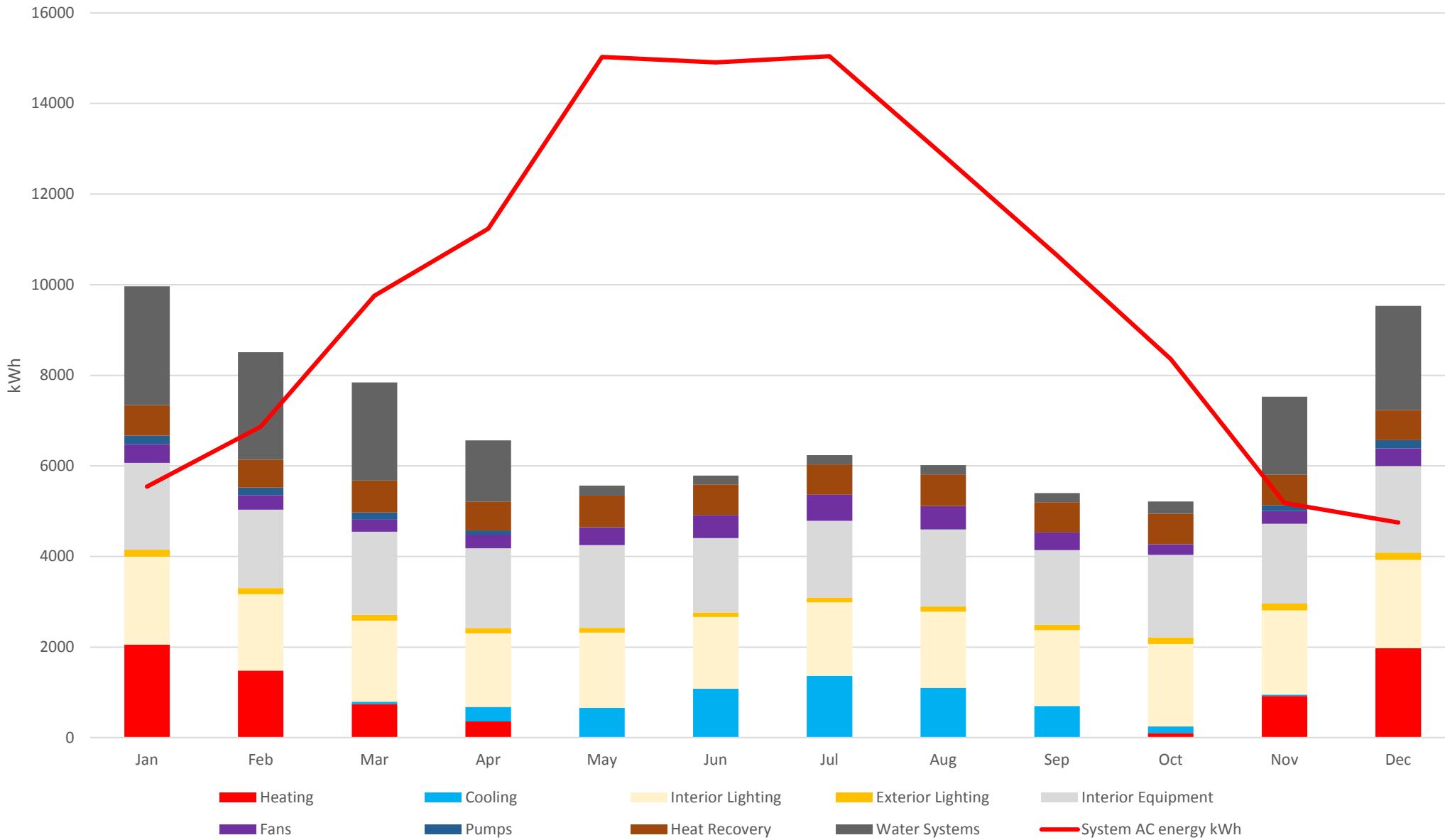
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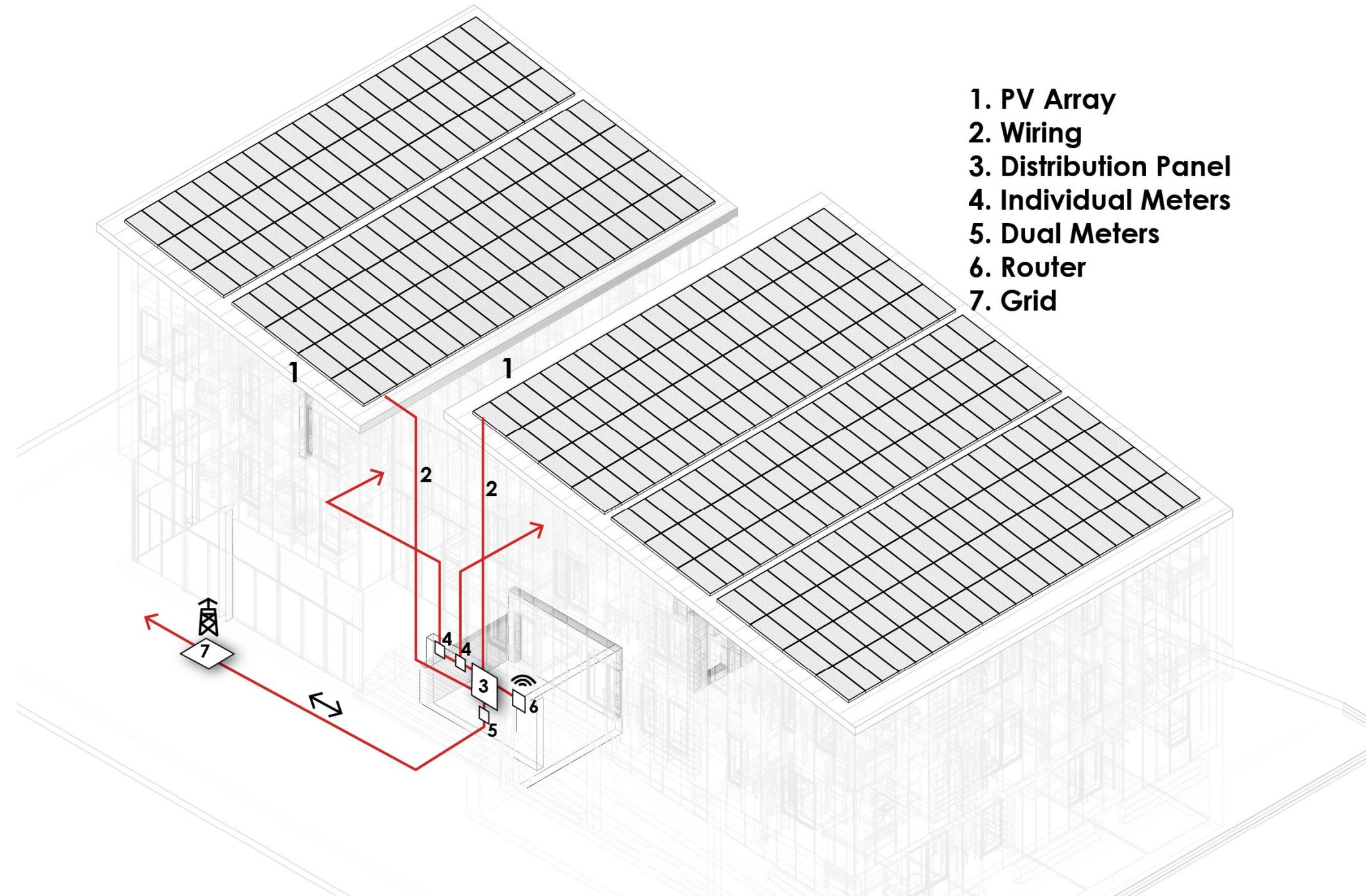
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InterTech's Energy Analysis - PV Generation vs. Consumption

**Energy Results**

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Sales Price Summary and Cost of Living

| | Baseline Design | Team Design |
|-----------------------------------|-----------------|-----------------|
| Total Sales Price | \$ 3,382,405 | \$ 4,038,162 |
| Monthly Household Debt (0.5% MFI) | \$ 295 | \$ 667 |
| Operations and Maintenance Costs | \$ 196 | \$ 170 |
| Monthly Utility Costs | \$ 160 | \$ 2 |
| Property Tax | \$ 332 | \$ 483 |
| Insurance | \$ 79 | \$ 98 |
| Mortagage | \$ 1,405 | \$ 1,169 |
| Total | \$ 2,467 | \$ 2,588 |
| Estimated Target Family Income | \$ 59,039 | \$ 133,322 |
| Debt to Income Ratio | 50% | 23% |

Assumptions:

- 2.5 students/unit
- 14 dwelling units

Income

\$ 62,3k year/student
\$ 133,322 year/total

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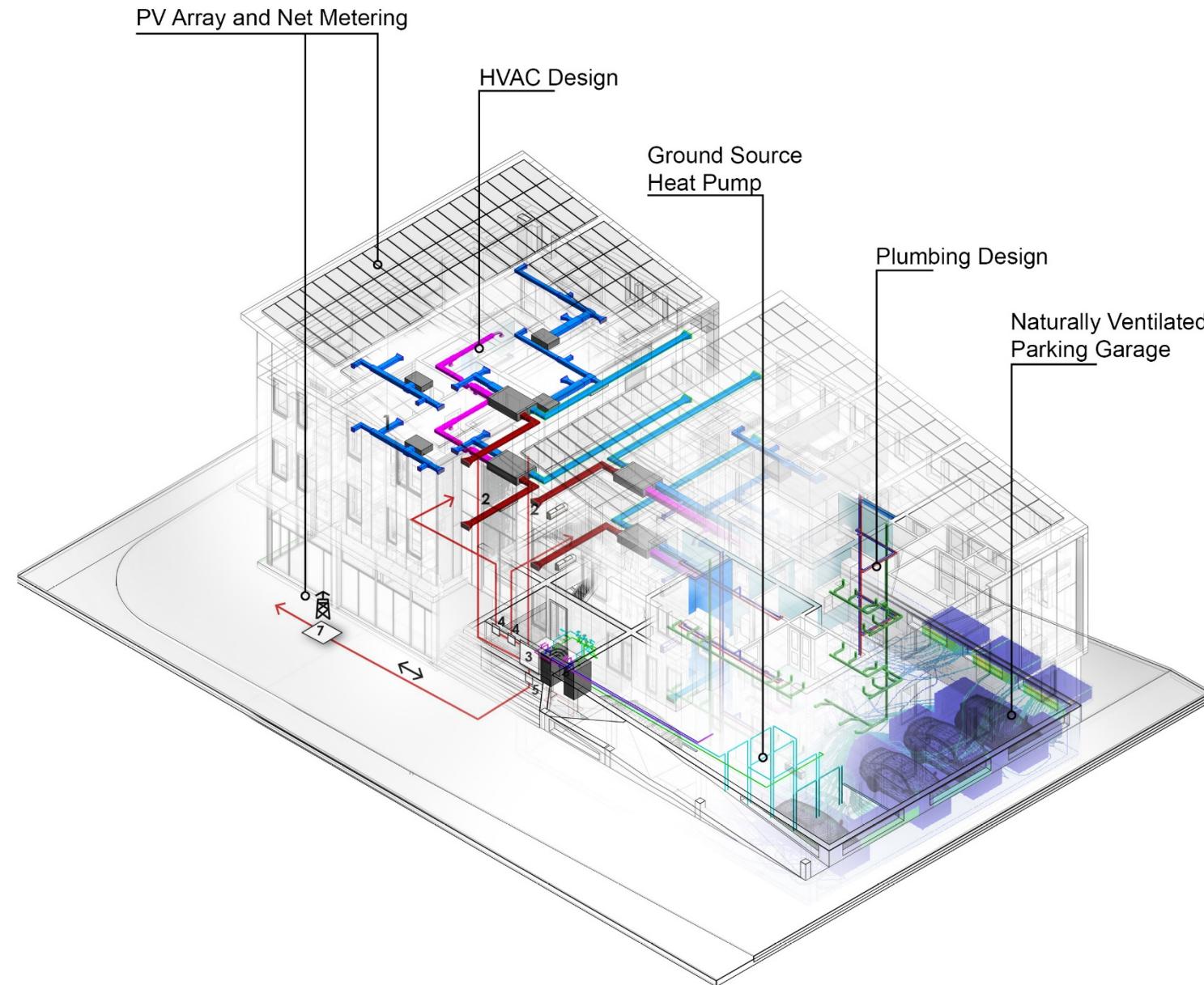
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Team Members



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Aerospace Engineering



Jaime Marin
M.E. Mechanical and
Aerospace Engineering



Ajay Kotur
M.E. Architectural
Engineering



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Engineering



Narjes Abbasabadi
Ph.D. Candidate in
Architecture



Vitoon Jittasirinuwat
M.E. Architectural
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